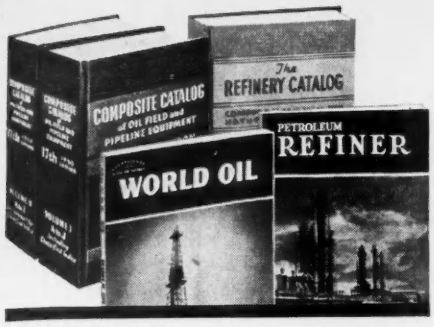

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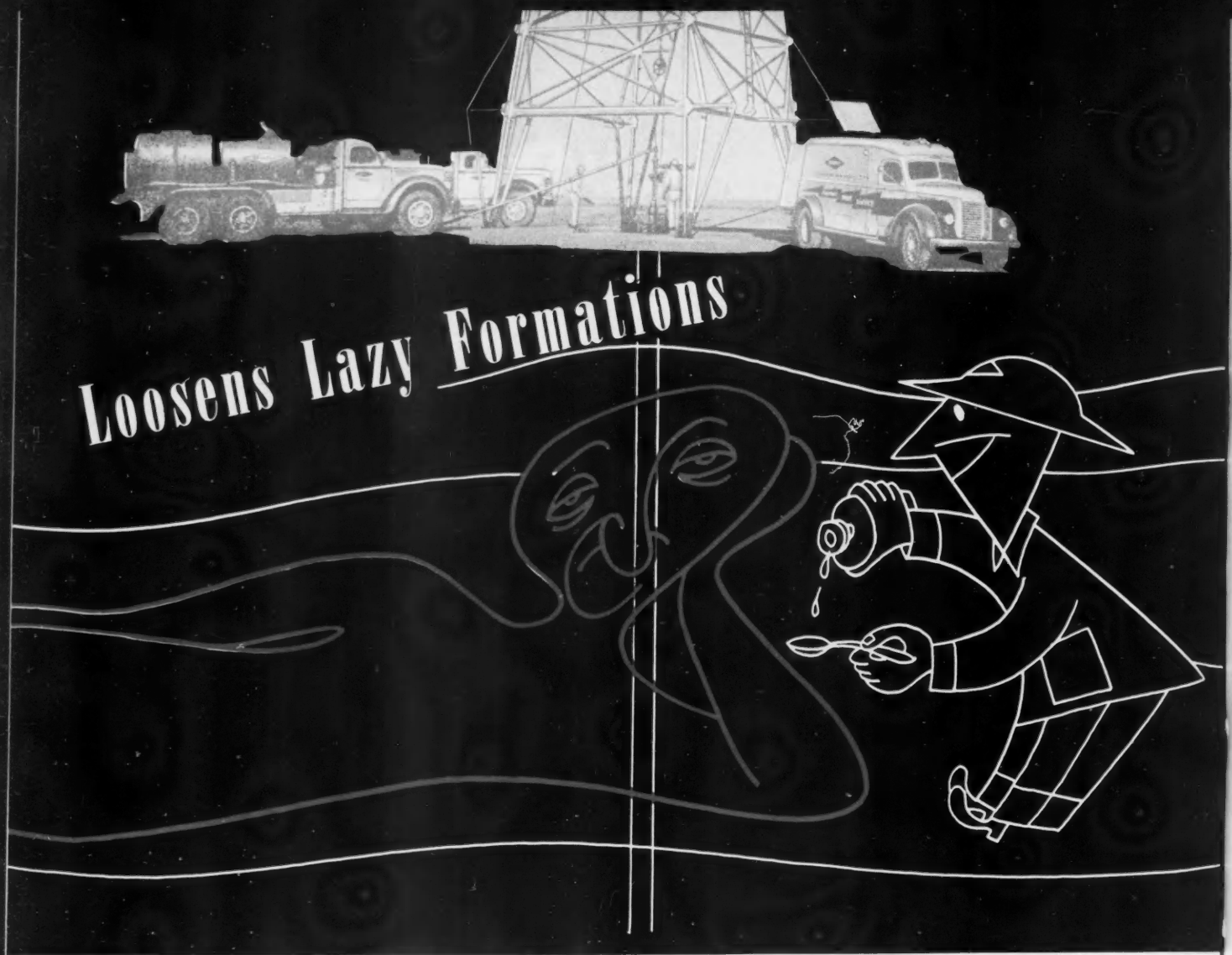

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DON'T EXPECT JOE TO DO IT

A VAST MAJORITY of the American people undoubtedly wish to see a halt to the growth of socialism in the U. S., but either are too busy or do not know what they can do to stop the trend.

This is largely the fault of American business. If the U. S. is not to become a socialistic state, business men must adopt a more active campaign to sell the public on the economy system which has given this country the highest standard of living in the world.

As Elmer L. Lindseth, president of the Edison Electric Institute and also president of the Cleveland Electric Illuminating Company, recently stated:

"The American people are being sold the socialistic furore by one of the most skillful sales campaigns ever conducted. While we on the other side are doing a great job of selling the products of our factories and in raising the standards of living of our people, we are shamefully neglecting the obvious job of selling the system that makes it all possible.

"By contrast most of us (business men) devote a pitifully small share of time to combating the forces we despise or selling the public on our ideals."

Certainly an active campaign is required. Business men must get informed on the American economic system so they can explain it clearly in terms everyone can understand. Stress must be laid on what the American business system means to better living conditions, security, independence, freedom and superiority.

Business has four groups to whom it should direct sustained, aggressive, educational campaigns. These are employes, stockholders suppliers and customers. These four groups constitute a sizeable portion of the country's citizenship.

Most business firms have several ready mediums of communication with a large portion of these groups. Employe publications, worker meetings, and foremen's sessions are some.

The important thing is not to sit idly by and "let Joe do it." This is a job for everyone, and if all business firms will begin such a campaign much can be accomplished in a short period of time.

PRICING SELF OUT OF MARKET

FEARING A PRICE WAR, Senator Kilgore of West Virginia wants the government to fix a minimum price for coal. If the government is going to sponsor high farm product prices, Senator Kilgore evidently thinks it should do the same for coal. John L. Lewis and President Truman are said to have raised no objections to the plan.

This is another example of the absurd economic planning which exists all too frequently these days in our political circles. No one seems to question whether it is fair and constructive that consumers should be required to pay artificially high prices for coal. Neither is any recognition given to the coal industry's basic problem, which is that Lewis' union has pushed costs to the point where coal has been priced out of much of the fuel market. Oil and gas have absorbed much of the fuel market because they not only are cleaner and more convenient but also are cheaper. A minimum coal price would only turn more consumers to petroleum for fuel.

Instead of easing the plight of the coal industry, such a measure could only cause it more and more economic pains.

Despite the immediate advantage gained, the petroleum industry should not rejoice at this prospect, as its benefits would be more than offset by the over-all damage to American economy. With such important industries as coal and agriculture supported by artificial prices, other businesses soon would seek similar economic assistance. There would be no end to the process. In the end, the government would be running all businesses—and the people would have to pay both higher prices and higher taxes.

Warren L. Baker

A RIG SIDE CHAT

about Baker Retainer Production Packers

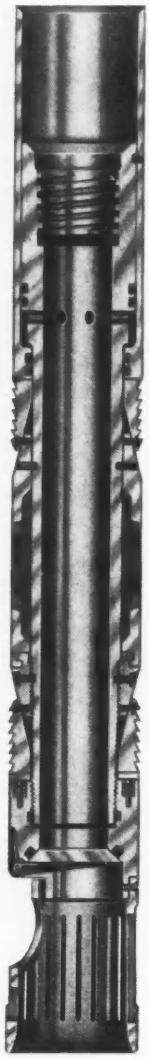
What we want to talk about today is how the Baker Production Packer is set securely in the casing, anchored against either upward or downward movement, with the tubing production string left free from the packer. The tubing is run through the body of the packer for production, and is free to be pulled at any time without disturbing the packer. In the typical application drawing (far right) the packer has been set and anchored to the casing by the two sets of opposing slips, with the Hycar packing unit sealed-off against the casing and retained in position by lead seals.

We want to produce from a zone below the packer so we make up the string with a Baker Perforated Production Tube on bottom (with operator's tubing to provide an additional stinger, if desired); above is a Baker Multi-V Tubing Seal Nipple; next a No Left Turn Latching Sub; and above that comes the tubing. Now we run-in the well until the Latching Sub engages in the top of the packer. The engaged Sub automatically positions the Multi-V Tubing Seal Nipple accurately in the smooth bore of the packer, and with 5 Hycar rings facing up and 5 more facing down, a perfect seal is obtained between the tubing string and the packer bore. Meanwhile, the Perforated Production Tube, as it was run through the bore of the packer, has unseated the Flapper Valve and now holds it in open position.

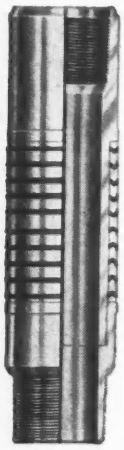
It's as simple as that, and we are ready to produce through the ⅜-inch holes in the Perforated Production Tube. These holes prevent junk, debris and large pieces of shale from entering and clogging the production string; and the total area of all holes is equal to or greater than the area of the tubing string.

When the tubing string is pulled at some future time, the Flapper Valve in the lower end of the packer body snaps back into the closed position and maintains a fluid-tight seal against upward pressure from below. The packer is not disturbed by pulling the tubing string, but remains packed-off against the casing ready for future operations.

This is only one of the many applications of the Baker Retainer Production Packer for single-zone or multiple-zone production; for selective testing and acidizing; for protection of casing from pressure or from destructive fluids, or gases; and other profitable uses.

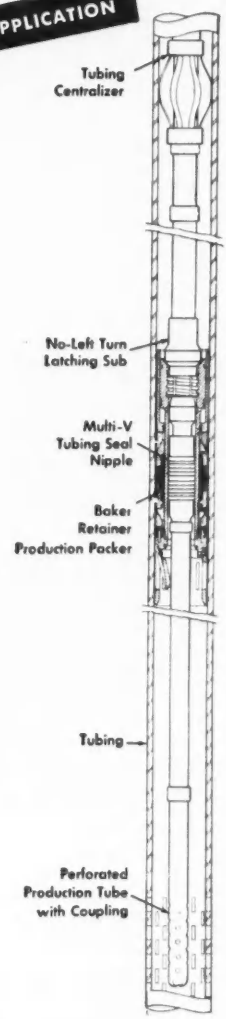


Baker Model "D" Retainer Production Packer Product No. 415-D



BAKER TUBING SEAL NIPPLE, MULTI-V TYPE, which effects a fluid-tight seal between the tubing string and the bore of the Packer.

TYPICAL APPLICATION



Single zone hook-up with production string anchored to packer, for: (a) keeping production string in tension to eliminate "tubing breathing" during the pumping cycle; (b) producing by flowing, without imposing excessive weight on packer to hold Tubing Seal Nipple positioned in packer bore; (c) making high pressure injection of gas or fluid for re-pressuring or secondary recovery.

Production string is run-in until No Left Turn Latching Sub rests on top of packer, indicated by drop in weight on strain gauge or weight indicator. The production string is then raised about 5 feet, and the zone washed and brought in, if it will flow.

If you would like to continue this rig-side chat at any well where you have a production packer problem, call the nearest Baker "Service Engineer." He will have helpful suggestions, and he is as near as your telephone . . .

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RETAINER PRODUCTION PACKER

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The Changing Panorama

By L. J. LOGAN, Associate Editor

UNLESS the oil and gas industries approve surrender of their businesses to bureaucratic government, they must regard veto of the Kerr-Harris bill as only a temporary setback and make a new and stronger fight for the freedom that Congress sought to guarantee by passing the bill.

The measure would have prevented the Federal Power Commission from regulating field sales of natural gas by independent producers and gatherers and would have forestalled similar control over oil produced along with gas. It was vetoed by President Truman after passing in the Senate by 44 to 38, and in the House by 176 to 174. Truman declared it "would not be in the national interest."

Because of the narrow margins of passage in both houses, proponents predicted no serious efforts to override the veto.

Reaction in the oil and gas industries probably was accurately voiced by J. Ed Warren, president of Independent Petroleum Association of America, who said the veto was "a victory for those in and out of government who are pushing us toward nationalization." He said, "A step to nationalize the fuel economy has now been taken. Unless corrected, it is inevitable that the next will be coal and then oil, and after that, all the basic industries of our country. Already there are a number of proposals in Congress that would lead us down that road . . . The real issue is government control versus free enterprise. It is time to stand up and be counted."

Representative Harris (D., Ark.), coauthor of the vetoed bill, said the presidential action was the "greatest blow that has been dealt to an industry which was getting ready to expand natural gas service to American homes." Harris charged that the veto resulted from a "political decision," following a campaign of "villification and misinformation on the part of opponents which was the worst I've ever observed." He said killing of the bill would cause curtailment of expected expansion of gas consumption. Already, he added, reports have started coming in of lessening of supplies, because producers are unwilling to run the risk that both their oil and gas operations will be brought under FPC regulation if they sell to interstate gas pipe lines. Consumers will have to pay higher prices because of the veto than if the measure had become law, he predicted.

R. B. Anderson, president, Texas Mid-Continent Oil & Gas Association, declared the veto would make it impossible for the petroleum industry to go ahead with the many gas conservation projects now planned; sharply curtail exploration for gas; and eventually reduce supply and raise prices of gas for use in northern and eastern markets.

Senator Connally (D., Texas) said he was greatly disappointed by the President's action. "Producers and gatherers of natural gas in Texas and elsewhere are entitled to sell their product," he declared, "without the strong arm of the law, operating through a tyrannical and arbitrary bureau, fixing their prices. Such a practice does not prevail as to other commodities and articles of merchandise."

In attempting to justify the veto, Truman claimed FPC regulation of gas sales to pipe lines was needed "to prevent unreasonable and excessive prices, which would give large windfall profits to gas producers, at the expense of consumers."

Actually, gas producers of the Southwest long have suffered both lack of markets and relatively low prices, are committed to long term contracts at specified prices on sales to pipe lines, and wanted the Kerr-Harris bill not for price considerations but for its guarantee of freedom from bureaucratic regulation. Sponsors of the bill even agreed to include in it a provision that FPC could watch gas prices and if they got out of line, recommend remedial action to Congress and the President. It was reported, furthermore, that sponsors of the bill, by including this provision, secured assurance from Truman that the measure would be signed if enacted. On that basis, the bill was passed with strong backing by the Democratic party. After it was sent to the President, pressure groups bombarded him with messages urging veto. Members of his own party declared the bill was vetoed for political reasons rather than for failure to be in the public interest.

So involved was the bill in propaganda and misrepresentation by some of its opponents that it was kept from becoming law through opposition of a Democratic President and strong Republican opposition in Congress. Enactment was achieved by sufficient Democratic votes for passage, despite majorities of Republicans voting against. Though the Republican party has been generally considered as being for free enterprise and against bureaucracy, the vote in the Senate included only 16 Republicans for the bill and 22 against it. Of the Democratic senators, 28 voted for it and 16 against. In the House, Democratic leadership made enactment possible, though by only a 176-174 margin.

After viewing maneuvers on the Kerr-Harris bill, as well as those on the depletion allowance and other Washington developments, Charles E. Simons, vice president and general manager of Texas Mid-Continent Oil & Gas Association, reported his observations to the association and concluded that "the oil industry faces a bitter fight for existence as a free enterprise." He said the bill was subjected to "one of the most vicious attacks ever launched by anti-business groups. These attacks came from many quarters, ranging from the National Association of Municipal Law Officers to the Americans for Democratic Action, the PAC, et cetera.

"A bitter and acrimonious public assault was made by several of the Washington newspaper columnists, political writers, cartoonists, and radio commentators.

"The effectiveness of these attacks is shown by a review of the legislative history of the gas bill," stated Simons. "Three years ago, the House of the 80th Congress passed the Moore-Grizley bill, which was a much more detailed and comprehensive bill on this subject. It passed after only slight debate by a vote of 254 to 64. This bill did not get to a vote in the Senate. Last year, the House passed, with scarcely any debate, the Kerr-Harris bill by a vote of 183 to 131, but Senate action was delayed until this year."

In bitterly fighting the bill, said Simons, opponents contended that unless producers were subjected to FPC control, prices to consumers would go up. "Heretofore," he pointed out, "it always has been repugnant to the American philosophy for government to fix the price of a commodity in the hands of a producer with the view of depressing that price in favor of the consumer."

Simons said events in House showed grave threat to oil industry freedom, as bill barely passed, though Speaker Sam Rayburn left the chair and made a forceful plea for it; the majority leader and majority whip were active in its behalf; the minority leader and the minority whip were supporting it; and those handling the bill worked with intelligence and enthusiasm.

Report from the Observatory

Industry's Outlook Improved

By RAY L. DUDLEY, Publisher, and WARREN L. BAKER, Editor

FAVORABLE TRENDS during the past month caused marked improvement in the oil industry's outlook for the immediate future, with the result that cautious optimism replaced the mixture of gloom which existed during recent months. The over-all picture improved to such a point that it was indicated the industry had a good chance of not experiencing any general price changes, something many feared when gasoline prices started dropping in March.

In direct contrast with last year, when demand was depressed throughout the first half, domestic demand during the first four months of 1950 exceeded both 1949 levels and forecasted volumes by substantial margins. This strong demand, coupled with reasonable refining rates, had a very beneficial influence on refined product inventories. Consequently, the mid-March downward trend in products prices seemed to have been arrested before it became widespread.

A late season flurry for heating oil was noted as some northern sectors of the country experienced colder weather than normal for this time of the year. This caused both distillate and residual fuel oil stocks to continue dropping farther below 1949 levels, and resulted in some upward trend in prices for these products during the past month. The beginning of seasonal drafts on motor fuel stocks appeared to be strengthening the gasoline market, which had demonstrated weaknesses in recent months, and prices were stable in contrast with March's downward trend.

• • •

CONSERVATIVE REFINING activity has been an important factor in the improvement in refinery product conditions. Additional improvement should occur in coming months, if crude runs to stills are held to reasonable rates during coming months.

A factor in reducing crude runs has been the strike at six refineries of The Texas Company. These plants have a combined total capacity of 342,000 barrels daily, and as this was written there was no indication when they might be able to reopen.

• • •

HIGHLY IMPORTANT was the change in the gasoline picture, which has been greatly strengthened in recent weeks. Encouraging was the beginning of drafts on gasoline stocks, which dropped from an all-time high of 135½ million barrels April 1 to 133½ million barrels April 15. This reduced them to the February 25 level.

Although gasoline inventories in mid-April were still 7½ million barrels above year ago volumes, only 3¾ million barrels of the increase occurred east of California. Furthermore, gasoline stocks do not appear to be high in relation to revised spring gasoline demand forecasts and can be expected to drop by steadily enlarged amounts during coming months. Maintenance of conservative refinery runs might permit them to be reduced to 1949 quantities within a few months.

Prices for gasoline remained steady in recent weeks, in contrast with several cuts during March.

• • •

FUEL OIL INVENTORIES have fallen at a fast pace for this late in the season as temperatures in some northern regions equaled that of January. The stocks now are in excellent condition, whereas they were regarded with some apprehension a year ago. With warm weather at hand, stocks of fuel oil will begin increasing, but their present low volumes presages they will not reach excessive quantities during the low consuming summer months.

Distillate fuel oil stocks have shown marked changes. During the three weeks ended April 15 they declined at a rate of 92,392 barrels daily, in contrast with an increase of 16,000 barrels per day in the corresponding period of 1949. Consequently, in totaling only 37½ million barrels on April 15, distillate fuel inventories were 11-2/3 million barrels below year ago levels. On March 18 they had been but 7½ million barrels beneath the corresponding period of 1949. Distillate fuel stocks outside of California are in even better shape than indicated by national figures, currently being 13½ million below a year ago.

Residual stocks also have dropped far below 1949 levels, as demand has exceeded expectations. Residual inventories on April 15 were slightly under 40 million barrels, or 19½ million barrels beneath year ago volumes. During the three weeks ended April 15 these stocks dropped an average of 95,179 barrels per day, while during the same period of last year they were enlarged by 44,214 barrels per day.

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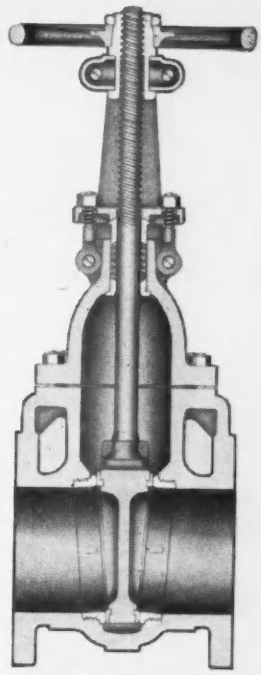

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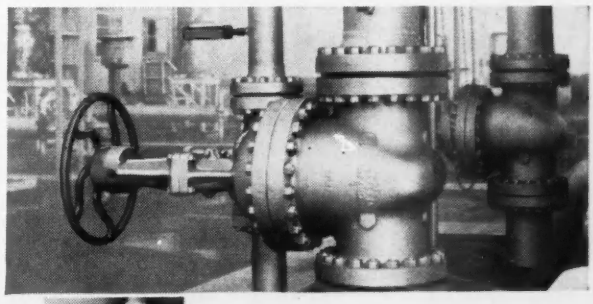

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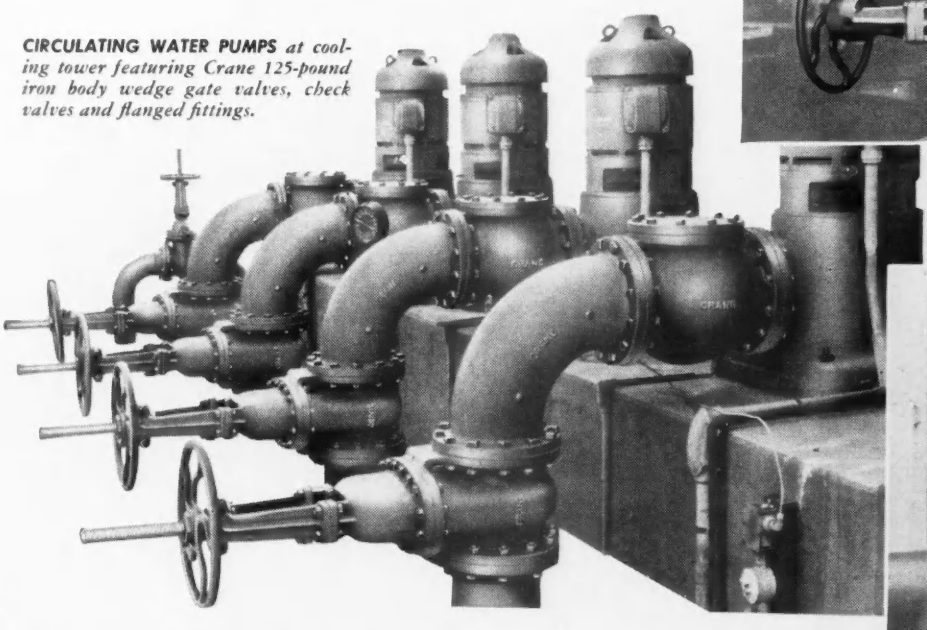
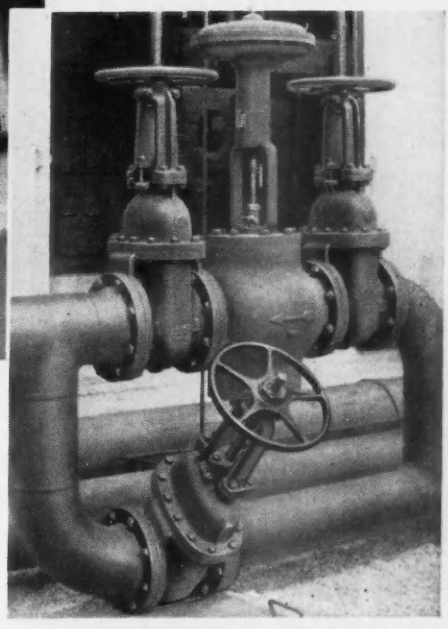


CRUDE OIL FIELD LINES *showing regulator with Crane iron body wedge gate valves in fabricated by-pass arrangement.*



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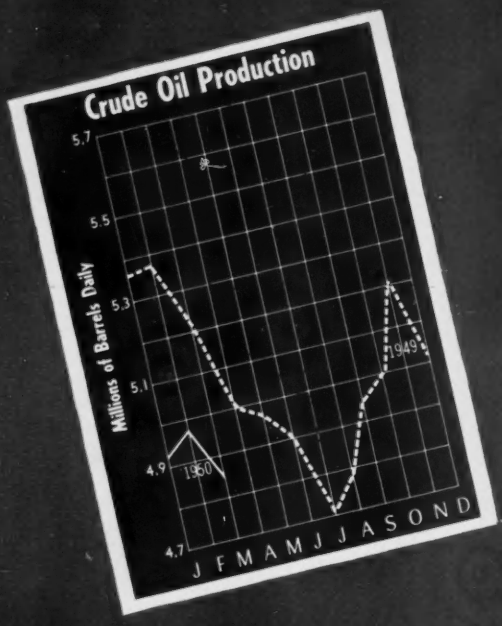
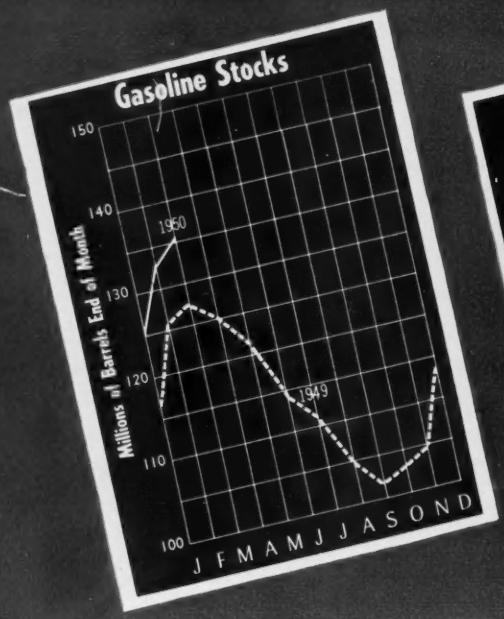
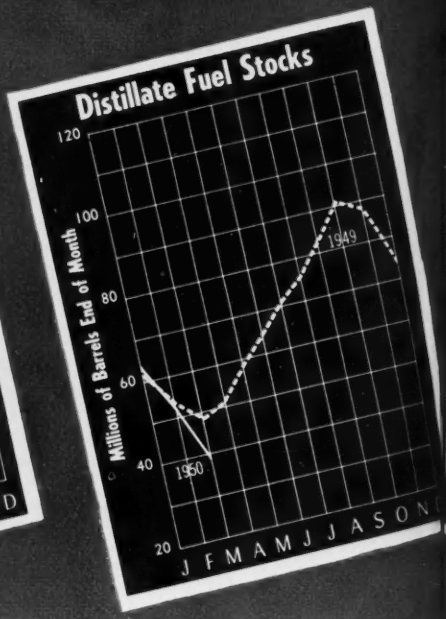
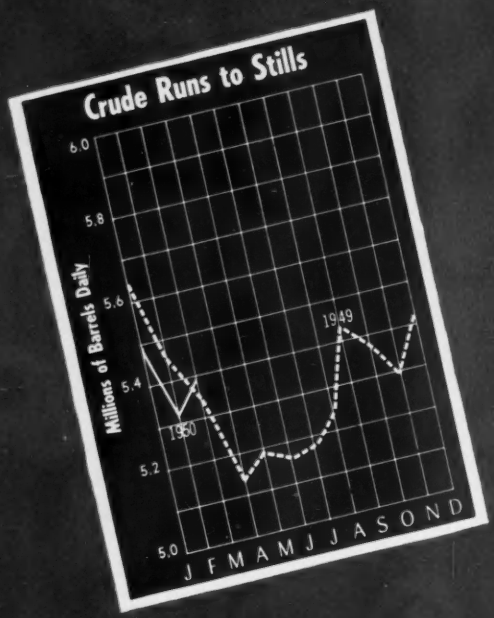
Petroleum

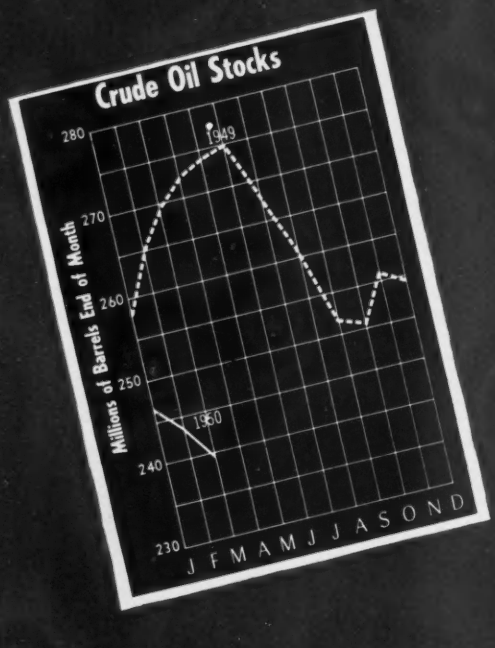
By CECIL W. SMITH
Statistical Editor







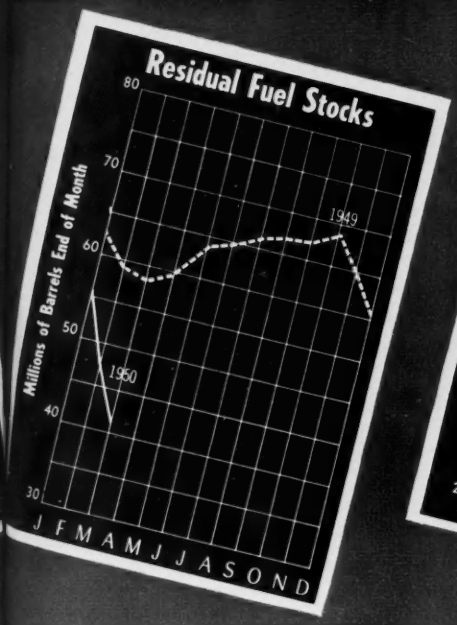


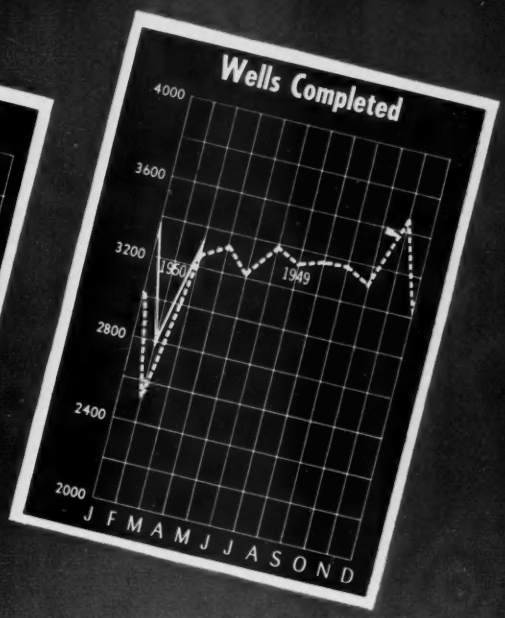


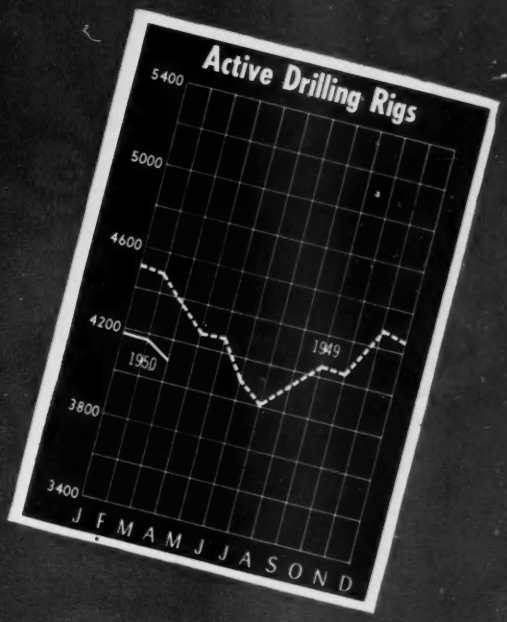
State Crude Oil Production
(THOUSANDS OF BARRELS)

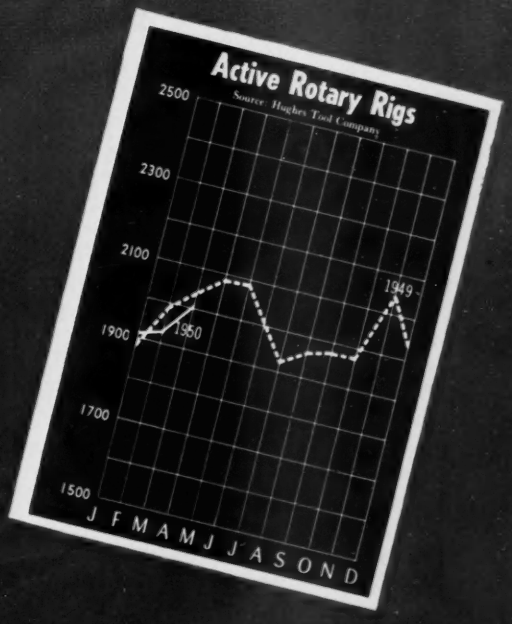
STATE or DISTRICT	DAILY AVERAGE PRODUCTION				TOTAL FIRST THREE MONTHS		
	March, 1950	February, 1950	March, 1949	% Diff. March, '49-'50	1950	1949	% Diff. '49-'50
Alabama	1.7	1.7	1.3	+ 30.8	151	112	+ 34.8
Arkansas	85.9	85.4	85.5	+ 0.5	7,721	7,721	.....
California	863.3	868.9	949.7	— 9.1	77,986	85,111	— 8.4
Colorado	58.5	58.9	63.2	— 7.4	5,341	5,800	— 7.9
Florida	1.1	1.0	1.2	— 8.3	93	108	— 13.9
Illinois	181.4	182.0	176.8	+ 2.6	15,839	15,484	+ 2.3
Indiana	27.5	27.0	23.7	+ 16.0	2,339	2,022	+ 15.7
Kansas	262.3	277.1	302.7	— 13.3	24,273	26,270	— 7.6
Kentucky	25.5	25.2	23.5	+ 8.5	2,184	2,042	+ 7.0
Louisiana	531.4	566.6	512.5	+ 3.7	49,716	46,703	+ 6.5
North Louisiana	125.6	129.6	119.0	+ 5.5	11,363	11,061	+ 2.7
South Louisiana	405.8	437.0	393.5	+ 3.1	38,353	35,642	+ 7.6
Michigan	44.3	44.6	45.4	— 2.4	4,008	4,138	— 3.1
Mississippi	100.6	101.3	109.1	— 7.8	8,983	9,991	— 10.1
Missouri	0.1	0.1	0.1	.....	2	9	— 77.8
Montana	20.7	22.0	26.1	— 20.7	1,868	2,227	— 16.1
Nebraska	1.5	1.7	0.6	+ 150.0	148	59	+ 150.8
New Mexico	127.9	129.3	136.0	— 6.0	11,653	12,080	— 3.5
New York	13.6	13.5	12.1	+ 12.4	1,166	1,089	+ 7.1
Ohio	9.0	8.9	9.8	— 8.2	809	829	— 2.4
Oklahoma	420.2	421.0	421.3	— 0.3	37,021	38,372	— 3.5
Pennsylvania	27.9	27.6	33.2	— 16.0	2,591	2,928	— 11.5
Tennessee	.....	.....	.....	.....	4	2	+ 100.0
Texas	1,880.6	1,943.5	2,159.8	— 12.9	173,526	204,595	— 15.2
Dist. 1—South Central	25.9	25.7	26.9	— 3.7	2,337	2,455	— 4.8
Dist. 2—Middle Gulf	115.5	113.0	142.2	— 18.8	10,306	13,947	— 26.1
Dist. 3—Upper Gulf	333.7	379.4	424.2	— 21.3	47,516	40,497	+ 17.3
Dist. 4—Lower Gulf-S.W.	184.2	181.5	207.5	— 11.2	16,398	19,766	— 17.0
Dist. 5—East Central	23.8	31.7	42.2	— 43.6	2,640	4,009	— 34.1
Dist. 6—Northeast	329.3	302.1	376.7	— 12.6	28,182	36,325	— 22.4
Dist. 7-B—North Central	62.4	62.1	60.9	+ 2.5	5,606	5,667	— 1.1
Dist. 7-C—West	49.9	49.7	47.0	+ 6.2	4,393	4,357	+ 0.8
Dist. 8—West	536.7	579.0	614.3	— 12.6	50,633	58,506	— 13.5
Dist. 9—North	130.0	130.1	126.3	+ 2.9	12,091	12,105	— 0.1
Dist. 10—Panhandle	89.2	89.2	87.3	+ 2.2	8,129	7,986	+ 1.8
Utah	2.7	2.6	0.2	+1250.0	255	14	+1721.4
Virginia	0.1	0.1	0.1	.....	9	9	.....
West Virginia	7.8	8.0	7.5	+ 4.0	706	654	+ 8.0
Wyoming	159.6	151.6	122.9	+ 29.9	13,851	11,177	+ 23.9
Total United States	4,855.2	4,969.6	5,224.3	— 7.1	442,243	479,546	— 7.8

nTrends in the U.S.









Crude Oil and Refined Products Trends

(THOUSANDS OF BARRELS)

MONTH	CRUDE OIL			GASOLINE		DISTILLATE FUEL		RESIDUAL FUEL	
	Production Daily	Runs to Stills Daily	Stocks End of Month	Production Daily	Stocks End of Month	Production Daily	Stocks End of Month	Production Daily	Stocks End of Month
1948:									
January	5,283	5,348	229,842	2,328	102,167	1,082	39,788	1,278	36,260
February	5,353	5,380	231,419	2,264	110,999	1,127	33,019	1,295	35,602
March	5,406	5,387	234,164	2,252	111,949	1,050	30,570	1,307	34,192
April	5,484	5,540	234,506	2,396	109,289	978	32,564	1,303	35,527
May	5,502	5,668	231,318	2,486	108,552	992	38,551	1,314	41,123
June	5,544	5,632	231,412	2,529	104,518	998	45,835	1,280	44,213
July	5,522	5,631	230,955	2,494	98,839	994	56,045	1,264	49,448
August	5,577	5,621	231,954	2,532	95,445	1,038	65,887	1,248	55,009
September	5,435	5,376	237,302	2,416	90,518	961	73,854	1,154	58,682
October	5,632	5,594	243,972	2,490	92,426	1,069	79,992	1,268	61,456
November	5,675	5,672	250,066	2,551	95,589	1,081	80,658	1,277	64,865
December	5,688	5,720	256,254	2,626	103,697	1,106	71,475	1,299	64,021
1949:									
January	5,365	5,641	258,648	2,538	116,621	1,063	61,584	1,348	62,508
February	5,376	5,480	265,216	2,484	126,054	1,004	53,937	1,282	59,398
March	5,224	5,352	269,341	2,470	127,443	993	48,923	1,258	58,190
April	5,012	5,141	272,520	2,494	125,351	846	51,231	1,147	59,668
May	4,972	5,195	273,912	2,585	121,602	813	57,442	1,138	63,576
June	4,903	5,162	274,691	2,597	114,041	771	64,730	1,041	64,628
July	4,704	5,173	267,586	2,613	111,217	835	71,553	1,040	66,084
August	4,780	5,241	260,585	2,593	104,879	902	76,037	1,078	66,843
September	4,940	5,427	251,689	2,617	101,799	1,002	83,213	1,110	67,117
October	4,997	5,373	250,932	2,643	103,287	1,001	90,643	1,141	68,673
November	5,210	5,293	256,010	2,594	104,707	962	88,212	1,180	65,112
December	5,024	5,475	253,356	2,633	111,521	1,032	75,207	1,203	60,193
1950:									
January	4,922	5,483	246,610	2,575	125,298	1,048	63,932	1,209	55,808
February	4,967	5,316	243,750	2,552	132,796	1,026	52,206	1,172	47,828
March	4,855	5,395	239,393	2,558	135,560	948	38,754	1,156	41,256
Mar., 1950 Change:									
In Month	—112	+79	4,357	+6	+2,764	—78	—13,452	—16	—6,572
In Year	—369	+43	—29,948	+88	+8,117	—45	—10,169	—102	—16,934
Week Ended: April 15, 1950	4,999	5,116	241,324	2,403	133,458	967	37,499	1,077	39,881
April 16, 1949	4,969	5,143	269,544	2,417	125,922	855	49,169	1,183	59,440

Monthly News Analysis

Government Lending Poses Threat of Nationalization

Government control of industry through loans to business has become a serious threat to private enterprise, recent developments show. Expansion of government financing of business is sought in proposed legislation, and recent publicity on large loans by the Reconstruction Finance Corporation has shown heavy use of public funds in recent years by financing private business. (Two proposed multi-million dollar loans lately considered by RFC involve oil and gas properties.) These developments represent a definite threat of nationalization of American industry. Nationalization of banking and credit was an important phase of the broad socialization program in England.

A fund of more than $1 billion for loans to "small business" is sought in bills that Senators Murray (D., Mont.) and Pepper (D., Fla.) said they planned to introduce in the Senate. The bills would set up a new division within RFC to handle the loans and authorize appointment of a Small Business Coordinator on the President's White House staff.

Much publicity on RFC loans has come out of investigations being made by Senate banking subcommittee headed by Senator Fulbright (D., Ark.). The subcommittee was told by Comptroller General Lindsay Warren that an RFC loan of $11,100,000 to Texmass Petroleum Corporation of Dallas was "a transaction without authority of law." He contended the loan could not be paid back within the maximum ten-year period as required by law setting up RFC. Though RFC late in April had not yet begun disbursement of the loan to the company, the RFC board of directors approved the loan last September. Testimony before the subcommittee indicated that the loan had been approved despite adverse reports by four agencies of RFC, including the headquarters loan review board.

In a letter invited by Senator Fulbright, Jesse H. Jones, Houston, former chairman of the board of RFC, charged that RFC now is being misused and prostituted in making loans and should be abolished. Jones gave these reasons why RFC should be closed out: "First, because none of the conditions which prompted the creation of the RFC and the various amendments to its powers exist today; second, government lending in competition with private business is not a proper function under our free enterprise system; third, because it is being prostituted when making such loans as the Kaiser-Frazer, the Lustron, the Texmass, and the Waltham Watch Company; fourth, because there is ample credit for all legitimate and justifiable loans."

At the Senate subcommittee hearings, question was raised as to the status of the $70 million RFC loan application of Glenn McCarthy, Houston oil and gas operator. Harvey Gunderson, RFC director, said he understood the application had been withdrawn or would be withdrawn soon. In Houston, McCarthy's only comment was that he had not done anything regarding the application.

Tide Water President Advises Cautious Policy in Industry

Caution or retrenchment, even in drilling, was recommended by William F. Humphrey, president of Tide Water Associated Oil Company in the company's annual report to stockholders. "Present conditions," he commented, "and those indicated for the future seem to counsel reductions rather than increases in capital expenditures. Most economists forecast that the future promises to be most competitive for the oil industry due to the increasing over-supply of oil in all areas in this country. As long as this condition prevails, sound business judgment would dictate caution or retrenchment, even in drilling, if possible; and the industry, if possible, within the law, should favor a moratorium on drilling to avoid increasing this over-supply. It would seem advisable to adopt this sort of policy rather than to attempt to cure the evils of over-supply with a price-cutting campaign of the type now threatening the industry in some sections of the country."

Possibility of some slowing down of drilling and development was foreseen also by Reese H. Taylor, president of Union Oil Company, in that concern's annual report. Taylor said that crude prices on the West Coast may have to be lowered and crude production further reduced, because of a 25-million-barrel excess of heavy fuel oil stocks. Though new supply in 1950 is in balance with demand, the surplus stocks may give serious trouble, he indicated. About 10 million barrels more fuel oil will be shipped to the East Coast in 1950, said Taylor, but adverse price developments on the East Coast, accelerated by increased imports, may make further fuel oil sales to that area even more uneconomical than past sales, which have been at very low prices considering prices of crude.

In discussing the outlook, Taylor said the current condition of over-supply was not a new or unique development; that there have been many such occasions before; and that in the long run, these situations tend to be self-corrective.

Quitclaim to Tidelands Not Likely During This Session

It remains highly doubtful that federal tidelands quitclaim legislation will be secured in this session of Congress, despite some recent progress. The House Judiciary Committee April 20 approved, 16 to 10, a bill giving coastal states clear title to the submerged lands three miles offshore, and an effort will be made to get it passed by the House. But whether it could pass the Senate and also survive a virtually certain presidential veto was doubtful.

In the case of Texas, claim to lands 10½ miles from shore would be recognized because of the treaty under which the state entered the union. From these limits to the edge of the continental shelf, the submerged lands would be owned by the federal government, but 37½ percent of oil and gas revenue therefrom would go to the states.

The committee previously voted down a bill by Representative Emanuel Cellar (D., N. Y.) that would have given all the tidelands to the federal government.

The bill approved provides that lands under federal jurisdiction shall be leased on a competitive bidding basis and that states shall exercise police and taxing powers to the edge of the continental shelf.

A bill recognizing state ownership of tidelands was enacted several years ago but was vetoed by President Truman on the ground that question of ownership was before Supreme Court in a federal suit against California. The court ruled that the federal government had sovereignty, and now has before it a similar suit against Texas and Louisiana.

Legislation Pushed to Hike Tariff on Imported Oil

Legislation to limit petroleum imports appeared late in April to have small chance of passage in this session of Congress, some sponsors of such bills conceded. There was still some possibility, however, that import duties on crude and products might be increased, thereby discouraging importations. The Gossett bill, proposing to boost the tariff from 10.5 cents to $1.05 a barrel, was being

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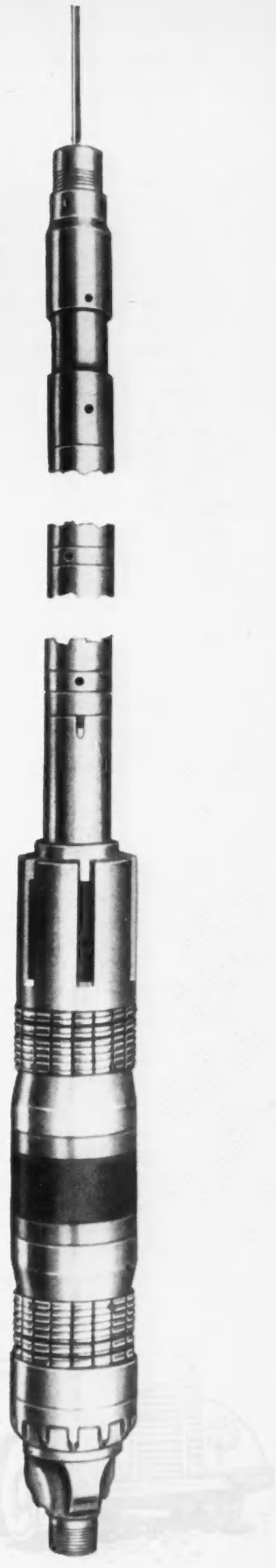

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pushed by its author and strong supporters.

Proposed Congressional limitations on oil imports have strong opposition as well as support. The Independent Oil Men's Association of New England has urged all New England members of Congress to oppose oil imports restrictions or reductions, asserting such limitations would force industrial, commercial, and domestic users of fuel oils to pay higher prices.

Assistant Secretary of State Willard Thorp claimed before a House subcommittee that the domestic oil industry had not been seriously hurt by petroleum imports and was not threatened with serious injury.

S. F. Gysin, a New York export broker, declared before the House Small Business Committee that oil imports are necessary to prevent excessive crude prices and to help provide foreign countries with dollars for buying U. S. refined products.

Robert Gray, editor of *Fueloil and Oil Heat*, argued before the same committee that limiting imports ultimately would injure the independent oil producer rather than help him by making oil prices relatively high and causing consumers to turn increasingly to natural gas for fuel. Producers profit relatively much less from sales of natural gas than from sales of crude oil, he contended.

To invade Eastern markets, natural gas pipe lines must sell three-fourths of capacity to industrial consumers on an interruptible basis at dump price rates, as heating use is seasonal, said Gray. To cover bare costs to pipe lines, minimum dump price is around 30 cents per thousand cubic feet, equivalent to a residual fuel oil price of $1.80 a barrel, or about the present price.

Imports supplied 70 million barrels of residual fuels last year, said Gray, and serious curtailment of this supply would force residual prices up sharply, causing manufacturers to ask for natural gas. This would result in use of more gas also for home heating and would reduce market for heating oil, he argued. In furnishing gas, the producer receives much less than for furnishing oil, he added. A Brooklyn home owner, using 1700 gallons of fuel oil a season at the present price of 10.8 cents, would pay $183.60 for it; and of this, the Southwestern well owner would receive $107.10, or 58 percent, stated Gray. If the consumer used gas instead, he would need 238 thousand cubic feet, and if he paid $183.60 for the gas, the same as for oil equivalent, only $14.28 of this, or 8 percent, would go to the Southwestern well owner, at 6 cents per thousand cubic feet; the remaining large proportion going to the trunk and distributing pipe line systems and their owners.

Texas Independent Producers and Royalty Owners Association at mid-April authorized R. L. Foree, president, to go east to confer with heads of importing companies after failing to get importers to send men to Austin for a conference. Some members of the group's executive committee, blaming importers for loss of markets for Texas oil, said they may ask Texans to boycott products of importing companies if other means fail to curb the inflow of foreign crude.

At Washington, a meeting was held in which tentative plans for an alliance against oil imports were made by representatives of several powerful groups, including coal operators, coal and railroad workers, and the IPAA. These groups claim loss of markets for coal and domestic oil to foreign oil and an attendant loss of employment of American workers in coal mines, on railroads, and in the oil industry. The groups have endorsed the Gossett bill for sharply increasing tariffs on oil imports.

California Conservation Law Not Expected This Session

Chances are growing slimmer that California's Governor Warren will see fit to place on the agenda of the current special session of the Legislature the proposed oil conservation measure actively sponsored by the Oil Producers Agency of California. The measure would set up a conservation system similar to those used by most other oil producing states and would replace the state's present voluntary system.

With state elections coming up June 6, it is believed the bill probably will not be brought up before the Special Session. If such turns out to be the case, proponents of the measure will see that it definitely is placed on the agenda of the next regular session to convene in January.

Conditions for Deduction of Exploration Costs Outlined

Six conditions have been specified by the Bureau of Internal Revenue in granting oil and gas operators the right to adopt a method of accounting whereby the costs of exploration may be deducted as expense for federal income tax purposes in the year in which they are incurred or paid. These conditions must be agreed on by each taxpayer before permission to adopt such accounting method will be granted. The conditions:

- All direct costs of geological and geophysical or other exploratory surveys and the portion of any overhead or general expense properly allocable thereto will be included.
- Such costs must be deducted in the year in which they are paid or accrued in accordance with the method of accounting employed, but only to the extent that they do not exceed the net income, before depletion, from the production of oil and gas from all properties.
- Such exploration costs in excess of the net income from producing properties will be carried over to the subsequent year and be treated as expenditures for such subsequent year with the same limitations.
- The amount deductible in the current year will be allocated to each property in the proportion that the gross income attributable to the production of oil and gas from each property bears to that from all productive properties.
- The amount allocable to an individual property will be used in determining the net income therefrom for the limitation of the percentage depletion deduction with respect to such property.
- If this method is used in reporting income for 1950, it must be used for all subsequent years until permission is obtained from the Commissioner of Internal Revenue to use some other method.

The Bureau admits it has had great difficulty in the treatment of exploration costs in the oil and gas and mining industries. On January 26, 1950, just two months before approval of the alternative method of accounting, the Deputy Commissioner of the Engineering and Valuation Division requested authority to publish in the Internal Revenue Bulletin a proposed ruling that "geological and geophysical costs constitute capital expenditures and are not deductible as business expenses under Sec. 23(a) (1) (A) of the Internal Revenue Code. If a property is acquired or retained on the basis of geological and/or geophysical data obtained from an exploration project, the cost of the project should be capitalized as part of the cost of the property acquired or retained. If no property is acquired or retained on the basis of such data, the cost of the project is deductible as a loss."

The Bureau has held that exploration costs are capital expenditures and are not deductible as business expenses for tax purposes. A letter from the Acting Deputy Commissioner of the Bureau to the Internal Revenue agent in charge at Chicago disclosed:

"As a result of numerous conferences with representatives of the industry, it has been decided to recognize that there are two acceptable methods of accounting for exploration costs. Such expenditures will continue to be regarded as capital in nature and will be handled in accordance with established Bureau policy as restated in the inclosed I.T. unless the individual taxpayer makes a timely application for permission to change his accounting method with regard to such expenditures as provided by Sec. 29.41-2 of Regulation III. Such permission will be granted only in those cases where the taxpayer agrees, as a condition of the

permission, to change the accounting method, to allocate all such expenditures to the production of that year as an overhead or general expense in the limitation of depletion provided that such expenditures do not exceed the net income from all oil and gas production. Any exploration costs in excess of the net income from all producing properties will be carried over to the following year to be added to like expenditures in that year and will be subject to like treatment. The amount to be subject to such treatment will be the same as that which is now included under the heading of geological and geophysical costs, that is, direct expenditures for that purpose and a reasonable allocation of such costs as are expended in other departments for the completion of such work."

Many operators felt that the new accounting option is not greatly to their advantage and did not apply for the changeover in accounting method by the deadline date of March 31.

Maritime Group Considering U. S. Aid in Tanker Building

The Maritime Commission has considered a proposal by Commissioner Joseph K. Carson, Jr., for the offering of long-term government contracts to private operators as an inducement to build high-speed tankers. The Navy reports a need for modern tanker tonnage and several private builders are reportedly interested in constructing the ships under such a plan.

Petroleum shipments in international trade have increased vastly over the last few years. With the completion of tankers now ordered, merchant shipping tonnage will be 13 percent above prewar levels, chiefly because of the 74 percent rise in tanker tonnage since 1939.

The world's tanker fleet now totals more than 30 million tons deadweight, of which about 9 million are under the U. S. flag. Tankers now constitute half the active U. S. merchant fleet and a fifth of the British fleet. The smaller shipbuilding yards in the U. S. have about nine-tenths of their orders in tank ships.

U. S. Has 13 Million Users of Gas, FPC Report Sets Forth

In the U. S. are 13 million domestic and commercial customers of companies distributing straight natural gas or mixed gas of which natural gas is a component, according to the annual report of the Federal Power Commission for 1949. "This means," says FPC, "that over 40 million people are affected by the operations of the natural gas industry."

The report shows that in 1948 utility sales of straight natural gas totaled more than 2.8 trillion cubic feet, or about six times the utility sales of manufactured gas.

Natural gas is now consumed in 34 states and the District of Columbia, with highest consumption in the Southwest, followed by the Appalachian area, California and the North Central areas. About 66 percent of all natural gas marketed in the U. S. in 1947 was consumed in the six producing states of Texas, Louisiana, California, Oklahoma, West Virginia and Kansas, which together produced 86 percent of the marketed production.

FPC finds that the "interstate movement of natural gas has steadily increased, particularly since 1931, and is expected to continue to increase at an accelerated rate." In 1938, when the Natural Gas Act was passed, interstate transportation totaled 636.6 billion cubic feet, while in 1947 the interstate movement was 1326.8 billion cubic feet, an increase of more than 100 percent. In 1947, movement of interstate natural gas represented 43.8 percent of all natural gas transported in pipe lines. "It is expected that the magnitude of such transportation will increase materially during the next year years," says FPC.

The report estimates that when all major facilities presently authorized or applied for are constructed, the volume of natural gas moving in interstate commerce will reach a total of about 3 trillion cubic feet a year.

From 1942, when FPC was given certificate jurisdiction over the construction of all facilities proposed for the transportation or sales of natural gas in interstate commerce, to June 30, 1949, the FPC issued 446 certificates of public convenience and necessity authorizing the construction of 27,500 miles of pipe lines and 1,603,000 compressor horsepower with an estimated cost of facilities aggregating $1628 million. This amount is 84 percent of the total investment in gas plants of companies reporting to the FPC in 1938. Applications for certificates pending June 30, 1949, involved proposed additional expenditures of $922 million.

FPC held that due to regulation of the gas industry, "the price of natural gas to the consumer has remained comparatively stable."

FPC continued to receive and process applications for authorization to construct and operate new and additional natural gas transmission facilities in the same heavy volume in 1949 as in the two previous years. For the fiscal year ending June 30, 1949, a total of 102 applications were filed for construction and operation of facilities involving 8690 miles of pipe lines and 374,564 additional horsepower at compressor stations at a total estimated cost of $725 million. During that year, 91 certificates were issued for construction and operation of 7045 miles of pipe line and 436,274 compressor horsepower at a total estimated cost of $566 million.

Bargaining Basis Big Issue In Texas Company Strike

More than ordinary significance was seen in the big strike against The Texas Company. The strike did not involve wage rates. It dealt with social objectives, including pensions, hospitalization, and other benefits, determination of job duties, and a 36-hour week. But perhaps most important of all angles was that the strike was on virtually a nation-wide basis, rather than involving individual plants independently.

This strike against a major company on a nation-wide or company-wide basis was highly significant to the whole industry. Similar strikes simultaneously against several major companies could disrupt the industry, cause a critical oil shortage, and paralyze the nation.

The Texas Company in a public statement declared that it believed the main purpose of the strike was "to force the company to agree to the desire of the union's international officials to bargain on a nation-wide basis instead of on the plant-by-plant basis which has been followed by the union and the company for nearly 15 years and has been established by the National Labor Relations Board as the appropriate basis for bargaining by the company." The statement said the company had "difficulty in seeing any justification whatever for these strikes."

The Oil Workers International Union, CIO, called strikes at the company's refineries at Port Arthur and Port Neches, Texas; Casper, Wyo., and Lawrenceville and Lockport, Ill. Approximately 7000 men were involved, including about 4500 at Port Arthur. Bargaining was still in progress in late April.

With minor variations by plants, the strikes involved proposed changes in the company's pension plan and accident and sick benefit plan, determination of job duties, and the 36-hour week. No demands were made for increased wages, and no other demand was made that would involve any direct money payment to employes. The company offered to make improvements in what it called its "already generous" pension, accident, sick benefit, and hospitalization plans and was willing to include the plans in labor contracts. A question regarding the 36-hour week arose because of unwillingness of the union to agree to continuance of the existing 40-hour week for the period to be covered by a new contract. The union sought right to raise the question of the 36-hour week any time during the contract period and to strike for it. The company questioned economic necessity for a 36-hour week during life of the contract and declared that on this question the union was striking over an issue that might never become real.

Looking Ahead

CONTINUED RISE IN DEMAND for oils and in petroleum industry employment in next 5 to 10 years is forecast by Bureau of Labor Statistics. Factors cited as promising these gains include prospective increases in number of motor vehicles in use, growth of military and civilian aviation, increased use of oil for heating, wider use of diesel engines, increasing importance of petroleum by-products, and growth of U. S. population and industry.

CURRENT PLANS of major oil importers will be revealed when Texas Railroad Commission holds next statewide proration hearing May 17. Commission asked them to be prepared to state how much crude oil they intend to import in latter half of 1950. Companies also were asked for opinions on essential stocks of crude, gasoline, and heating oil April 1 and September 1 this year, or at beginning and end of heavy gasoline consuming season.

JOINT AND COOPERATIVE oil and gas operations are increasingly desirable and essential in many cases, and will help keep small, independent operator in business, in face of ever-increasing financial requirements and hazards. This was pointed out by Walace Hawkins, Magnolia Petroleum Company, at API production division meeting in Oklahoma City.
A cooperative venture divides hazards, he said, and holds capital investment within limits of the small operator. Expert and technical staff advice and services, made available on fractional cost basis, place small or part-interest producer on equal terms with larger and more financially secure participants. Unitized operations are not designed to displace wholly owned and operated lease operations, he said, but to be used where they do better and more efficient job.

BUDGET PAYMENT PLANS for household fuel oil consumers will be promoted by some Eastern marketers this summer. They hope these plans will stimulate business. While spread-out payments offer advantages to consumers, making purchases easier, they also facilitate operations and deliveries of marketers.

FURTHER LARGE LOSSES of oil sales by foreign affiliates of American companies will occur in 1950, business going to British-Dutch and other concerns, if present currency exchange restrictions continue. This was forecast by Standard Oil Company (N. J.) in annual report, which said it lost 16 million barrels of crude and product sales in 1949 because of British trade and exchange restrictions. The Texas Company previously warned that British barring of American oil sales in foreign Markets threaten ability of U. S. firms to hold foreign concessions.

FUEL MANUFACTURE AND SALES as well as engine applications within oil industry may be importantly affected by lightweight gas turbine, developed by Boeing Airplane Company under Navy sponsorship. This revolutionary engine operates on gasoline, kerosine, light or heavy fuel oil, or "bottled gas"; is non-sensitive to octane or cetane ratings; eliminates cooling system. It has successfully powered heavy-duty truck and has possibilities for use on automobiles, railroad locomotives, pipe line pump or compressor stations, drawworks and pumps of drilling rigs, tractors, earth-moving machinery, cabin cruisers, speedboats, launches, small barges.

GAS MANUFACTURED FROM COAL is unlikely to be competitive with either natural gas or fuel oil, trends in fuels economics indicate. This view was expressed to American Institute of Chemical Engineers by Battelle Memorial Institute fuels experts Dr. John F. Fister and Dr. Richard J. Lund. One of best means for coal to maintain and expand its markets, he said, is through promotion of use of electricity, especially for railroad electrification and other heavy uses.

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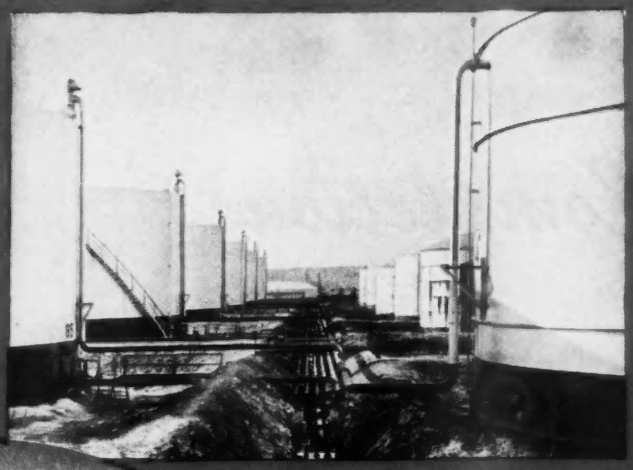

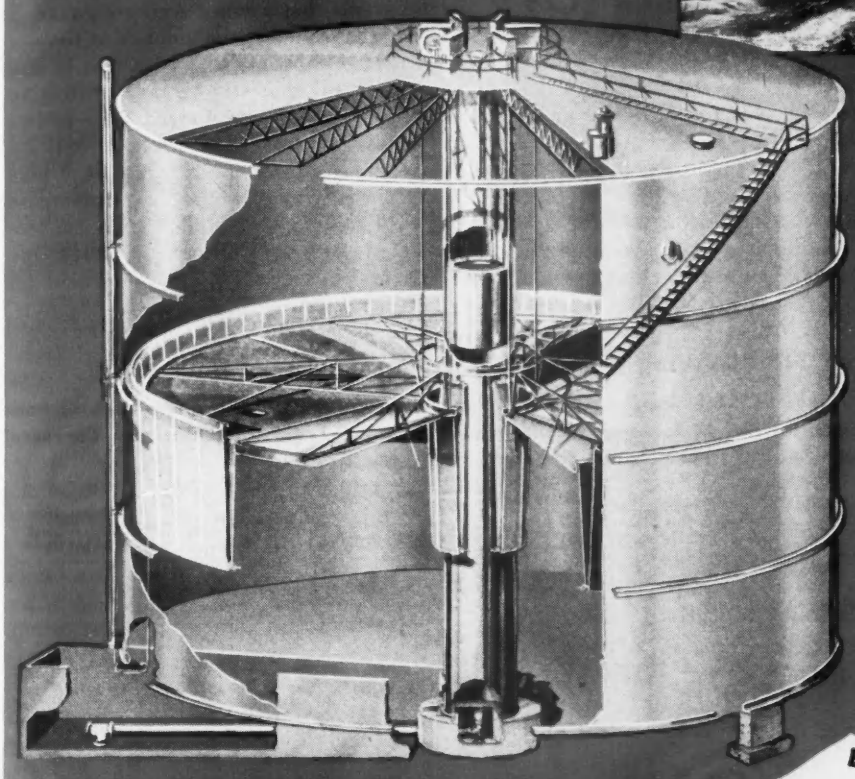

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Completions

Climb in March

DRILLING rates were higher in March than they had been in either the month before or in March of last year. As a result of this stepup, the current drilling campaign held on to its lead over last year's activity and at the end of the first quarter was holding a 7.9 percent advantage in the number of wells completed.

Well completions totaled 3337 in March compared with 2799 finaled in February and 3276 in March, 1949. Actually, a fair comparison of March and February is obtained only by a reduction to wells per day. On that basis, 100 wells per day were recorded in February, while March's averaged 108 daily.

At the end of the first three months, total well completions numbered 9504 to show a gain of 7.9 percent over the 8812 recorded in last year's comparable period. This year's wells would show an even greater increase if compared with those drilled in the first quarter of 1948, the greatest drilling year in history, but it should be remembered that 1948 drilling activity had a relatively slow start.

A comparison of wells drilled shows in part the difference between drilling programs, but a more accurate gauge of work expended is the amount of footage drilled in those wells. And it was in that department that the nation's drillers so far this year far surpassed their efforts in any previous comparable period. By the end of March, 35,280,172 feet of hole had been drilled, which was an increase of 10.4 percent over the 31,970,096 feet drilled last year, which recorded the greatest amount of hole ever drilled.

Well Completions in the United States During March, 1950, and Cumulative for Year

(Figures compiled by WORLD OIL Staff from private reports and other sources as follows: Illinois from Illinois Geological Survey; Indiana from Indiana Division of Geology; Missouri from Missouri Geological Survey; Tennessee from Tennessee Division of Geology; Bradford, Kane-Clarendon and Allegany fields of Pennsylvania and New York from the *Producers Monthly*)

STATE or DISTRICT	MONTHLY COMPLETIONS, MARCH, 1950									TOTAL COMPLETIONS				CUMULATIVE TOTAL				Rigs in Operation (Drilling, Rigging Up and Shut Down)		
	NEW WELLS																			
	Oil	Dist.	Gas	Dry	Water Input	Gas Input	Water Disposal	Total New	Total Drilled Deeper	Mar., 1950	Feb., 1950	Mar., 1949	Footage March, 1950	Wells 1950	Wells 1949	Percent Diff.	Footage, 1950	Mar. 31, 1950	Feb. 28, 1950	Mar. 31, 1949
Alabama				3				3		3	2	1	8,820	8	2	+300.0	26,720	1	1	5
Arizona												2			3	−100.0		5	4	6
Arkansas	20			12				32		32	27	20	101,949	90	60	+ 50.0	289,915	22	19	25
California	102		2	30		1		135	13	148	139	248	598,388	456	668	− 31.7	1,867,750	194	259	267
Colorado												5		7	9	− 22.2	19,275	14	11	26
Florida				2				2		2	3	5	17,388	6	7	− 14.3	41,116	1	4	1
Georgia				1				1		1		1	3,810	2	2		9,075		1	1
Idaho				1				1		1			3,812	1			3,812	2	2	
Illinois	55		1	88			1	145		145	132	139	354,004	453	439	+ 3.2	903,697	171	164	190
Indiana	40		4	54			1	99		99	86	99	173,087	286	227	+ 26.0	490,646	150	139	129
Kansas	151		18	108			3	280		280	248	247	915,543	788	639	+ 23.3	2,589,996	269	298	263
Kentucky	28		24	23				75		75	60	74	141,323	195	214	− 8.9	370,054	85	89	75
Louisiana	99	16	13	49				177	1	178	146	165	1,097,834	558	459	+ 21.6	3,450,158	238	238	202
North Louisiana	53	8	13	18				92	1	93	72	73	344,051	277	214	+ 29.4	1,027,638	67	69	60
South Louisiana	46	8		31				85		85	74	92	753,783	281	245	+ 14.7	2,422,520	171	169	142
Maryland				1				1		1			3,612	1			3,612	1	1	
Michigan	26			32				58		58	54	73	166,102	179	219	− 18.3	448,992	132	120	106
Mississippi	6	8		19				33		33	21	38	251,313	88	83	+ 6.0	656,706	32	30	31
Missouri	1		4	2				7		7	1	1	7,263	12	2	+500.0	9,667	9	9	6
Montana	10			5				15		15	8	18	82,902	32	44	+ 27.3	127,665	16	22	46
Nebraska	3		1	2				6		6	5		24,236	16		+100.0	62,809	4	5	1
New Mexico	33		1	7				41	1	42	46	42	194,910	146	125	+ 16.8	680,946	71	80	95
New York	26			1	18			45		45	60	150	66,749	175	383	− 54.3	246,609	78	93	146
North Dakota																				1
Ohio	26		19	27				72	3	75	74	81	166,209	211	263	− 19.8	466,822	137	135	152
Oklahoma	260	1	18	133	5		1	418	6	424	386	376	1,455,565	1,200	888	+ 35.2	4,156,248	553	550	484
Pennsylvania	38		27	9	32	8		114	2	116	124	159	220,348	357	634	− 43.7	660,181	191	204	327
South Dakota														1			5,710			2
Tennessee															6	−100.0		8	8	7
Texas	969	23	37	402	5		2	1,438	25	1,463	1,075	1,243	6,084,340	3,946	3,177	+ 24.2	16,634,802	1,407	1,376	1,362
Dist. 1—S. Central	15	1	1	26				43	2	45	29	60	133,060	112	149	− 24.8	324,737	30	31	41
Dist. 2—Middle Gulf	26	6	2	17				51	2	53	39	51	315,073	131	136	− 3.7	781,495	56	54	65
Dist. 3—Upper Gulf	80	3	6	47				136	2	138	100	110	794,707	366	323	+ 13.3	2,112,691	117	109	146
Dist. 4—Lower Gulf-SW	87	11	4	44				146	3	149	93	164	716,037	388	390	− 0.5	1,817,398	113	117	115
Dist. 5—E. Central	7	1	1	4				13		13	13	15	67,959	39	61	− 36.1	187,518	27	20	29
Dist. 6—Northeast	39	1	8	13				61		61	29	111	278,287	164	239	− 31.4	747,875	33	39	35
Dist. 7-B—N. Central	91		5	75			1	172	2	174	129	184	547,940	455	408	+ 11.5	1,410,715	150	154	198
Dist. 7-C—W. Central	56			29				85	3	88	52	33	341,638	217	61	+225.7	903,494	86	90	53
Dist. 8—West	318			9				327	11	338	247	216	1,766,463	960	584	+ 64.4	5,131,651	499	477	408
Dist. 9—North	199		4	135	5		1	344		344	246	241	938,791	865	546	+ 58.4	2,419,757	192	185	135
Dist. 10—Panhandle	51		6	3				60		60	98	58	184,385	249	280	− 11.1	797,470	104	100	137
Utah				2				2		2	1	6	4,370	4	9	− 5.6	14,713	8	5	14
Virginia																		1	1	
Washington				1				1		1			6,688	1			6,688	1	1	
West Virginia	16		21	14				51	2	53	51	35	110,526	160	117	+ 36.8	377,178	261	247	302
Wyoming	21		1	9				31	1	32	50	48	152,165	125	133	− 6.0	658,610	52	53	96
Total U. S.	1,930	48	191	1,037	60	9	8	3,283	54	3,337	2,799	3,276	12,413,256	9,504	8,812	+ 7.9	35,280,172	4,114	4,169	4,368

Outlook for *Demand* Brighter

By L. J. LOGAN
Associate Editor

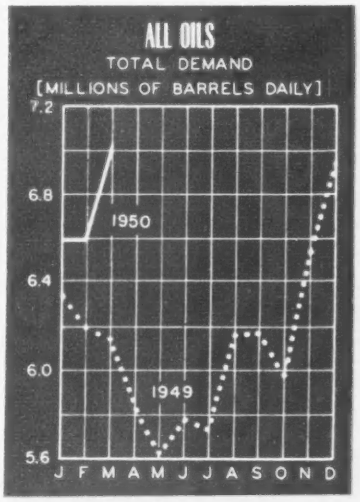
THE outlook for domestic crude producers appears more favorable than may be generally realized, because demand for petroleum products has been better than expected. Through protracted curtailment of production, surpluses of stocks have been largely eliminated, and operations henceforth should reflect more directly the favorable trends of demand.

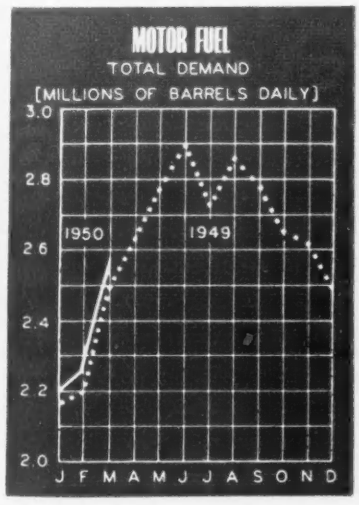
Domestic production would have had to be materially higher than in the first quarter of 1950 to meet the gratifying demand for petroleum products, if corrective adjustments had not been still under way.

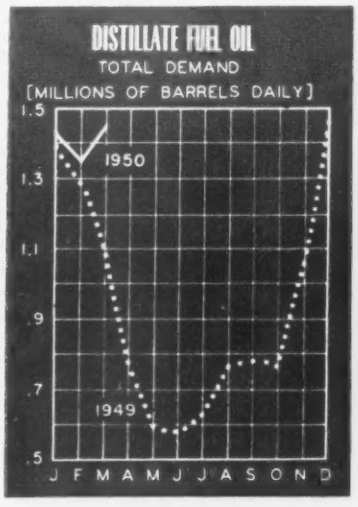
Total demand for all oils in the first three months of this year set a new record for the period. It averaged 6,744,000 barrels daily, an increase of 517,000 barrels daily or 8.3 percent over the 6,227,000 daily of the like period in 1949 and compared with 6,317,000 daily in the initial quarter of 1948. A total demand of only 6,551,000 barrels per day for this year's first quarter had been forecast by the Bureau of Mines at the beginning of the year.

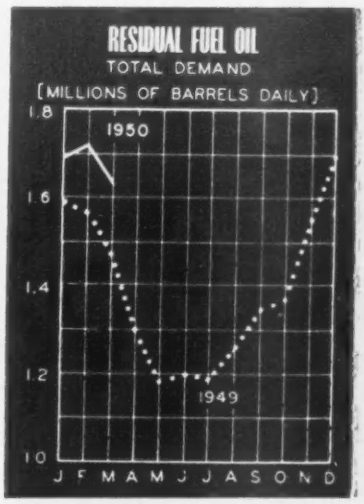
In spite of the 517,000 barrels per day increase in demand, domestic crude production of 4,914,000 barrels per day in this year's first quarter was 414,000 barrels daily or 7.8 percent under the 5,328,000 daily of last year's first quarter. At first glance, it might appear that crude production was in excess of 900,000 barrels a day lower than seemed justified. However, the disparity was caused by several important factors. Most important was the fact that in last year's first quarter stocks of all oils were increased 101,000 barrels daily while in this year's initial quarter they were drawn down sharply at the rate of 587,000 barrels daily, thereby cutting out nearly 700,000 barrels a day of crude production, as compared with last year. A second important factor was production of 485,000 barrels per day of natural gasoline in this year's first quarter, an increase of 64,000 daily over last year; and this additional natural gasoline displaces more than twice that amount of crude oil in gasoline-making, as crude yields only about 43 percent gasoline. Finally, total imports of 757,000 barrels daily in the first quarter of 1950 were 178,000 daily or 30.7 percent above last year's 579,000.

Demand has been better than expected for each of the major products, motor fuel, distillate fuel oil, kerosine, and residual fuel oil. As shown in the table on the next page, motor fuel shows an increase of only 2.7 percent, but kerosine is up 14.8 percent, distillate fuel oil 12.0 percent, and residual fuel oil 9.1 percent, though residual was expected to show little or no gain.









Demand for and Supply of All Oils, Crude Oil, Motor Fuel, Kerosine, Fuel Oil, and Lubricants

Sources: U. S. Bureau of Mines except February and March, 1950, estimated with aid of A.P.I. reports

(THOUSANDS OF BARRELS)

ITEM	First 3 Months, 1949	First 3 Months, 1950	Percent Change
ALL OILS			
Domestic Production, Total	517,408	485,984	— 6.1
(Daily Average)	5,749	5,400	— 6.1
Crude Petroleum	479,546	442,243	— 7.8
(Daily Average)	5,328	4,914	— 7.8
Natural Gasoline	37,829	43,678	+ 15.5
(Daily Average)	421	485	+ 15.5
Benzol	33	63	+ 90.9
(Daily Average)	.....	1	+ 90.9
Imports, Total	52,139	68,130	+ 30.7
(Daily Average)	579	757	+ 30.7
Crude Petroleum	37,323	41,051	+ 10.0
(Daily Average)	415	456	+ 10.0
Refined Products	14,816	27,079	+ 82.8
(Daily Average)	164	301	+ 82.8
Changes in Stocks, All Oils	+9,101	—52,856	.....
(Daily Average)	+101	—587	.....
Stocks, Beginning of Period	605,743	603,119	— 0.4
Crude Oil	256,627	253,356	— 1.3
Refined Products	343,537	342,932	— 0.2
Natural Gasoline	5,579	6,831	+ 22.4
Stocks, End of Period	614,844	550,263	— 10.5
(Days' Supply)	99	82	— 17.2
Crude Oil	269,341	239,393	— 11.1
Refined Products	338,098	303,070	— 10.4
Natural Gasoline	7,405	7,800	+ 5.3
Demand, Total	560,446	606,970	+ 8.3
(Daily Average)	6,227	6,744	+ 8.3
Exports, Total	31,417	21,798	— 30.6
(Daily Average)	349	242	— 30.6
Crude Petroleum, Total	5,935	6,380	+ 7.5
(Daily Average)	66	71	+ 7.5
Refined Products, Total	25,482	15,418	— 39.5
(Daily Average)	283	171	— 39.5
Domestic Demand, Total	529,029	585,172	+ 10.6
(Daily Average)	5,878	6,502	+ 10.6
CRUDE PETROLEUM			
Supply:			
Domestic Production, Total	479,546	442,243	— 7.8
(Daily Average)	5,328	4,914	— 7.8
Imports, Total	37,323	41,051	+ 10.0
(Daily Average)	415	456	+ 10.0
Change in Stocks	+12,714	—13,963	.....
(Daily Average)	+141	—155	.....
Stocks, Beginning of Period	256,627	253,356	— 1.3
Stocks, End of Period	269,341	239,393	— 11.1
(Days' Supply)	48	43	— 10.4
Supply, Total	504,155	497,257	— 1.4
(Daily Average)	5,602	5,525	— 1.4
Demand			
Runs to Stills, Total	494,654	486,266	— 1.7
(Daily Average)	5,496	5,403	— 1.7
Domestic Crude	457,415	444,353	— 2.9
(Daily Average)	5,082	4,937	— 2.9
Foreign Crude	37,239	41,913	+ 12.6
(Daily Average)	414	466	+ 12.6
Exports, Total	5,935	6,380	+ 7.5
(Daily Average)	66	71	+ 7.5
Transfers to Fuel Oil Stocks	2,232	2,054	— 8.0
(Daily Average)	25	23	— 8.0
Distillate Fuel Oil	766	669	— 12.7
Residual Fuel Oil	1,466	1,385	— 5.5
Used as Fuel, and Losses	1,334	2,557	+ 91.7
(Daily Average)	15	28	+ 91.7
Demand, Total	504,155	497,257	— 1.4
(Daily Average)	5,602	5,525	— 1.4
KEROSINE			
Production, Total	28,301	30,837	+ 9.0
(Daily Average)	314	343	+ 9.0
Percent Yield from Crude	5.7	6.3	.....
Imports, Total	.....	245	.....
(Daily Average)	.....	3	.....
Change in Stocks	—6,094	—8,388	.....
(Daily Average)	—68	—93	.....
Stocks, Beginning of Period	23,895	20,888	— 12.6
Stocks, End of Period	17,801	12,500	— 29.8
(Days' Supply)	47	28	— 40.4
Demand, Total	34,395	39,470	+ 14.8
(Daily Average)	382	439	+ 14.8
Exports, Total	972	307	— 68.4
(Daily Average)	11	4	— 68.4
Domestic Demand	33,423	39,163	+ 17.2
(Daily Average)	371	435	+ 17.2

ITEM	First 3 Months, 1949	First 3 Months, 1950	Percent Change
MOTOR FUEL			
Production, Total	231,161	235,684	+ 2.0
(Daily Average)	2,568	2,619	+ 2.0
Refinery Gasoline, Total	205,518	208,440	+ 1.4
(Daily Average)	2,284	2,316	+ 1.4
(Yield from Crude)	41.7	42.9	.....
Natural Gasoline, etc	37,829	43,678	+ 15.5
(Daily Average)	421	485	+ 15.5
Less Sales of L.P.G.	11,580	15,655	+ 35.2
Less Transfers Cycle Prods	639	842	+ 31.8
Benzol	33	63	+ 90.9
Imports, Total	.....	.....	.....
(Daily Average)	.....	.....	.....
Change in Stocks	+25,167	+24,110	.....
(Daily Average)	+279	+268	.....
Stocks, Beginning of Period	101,060	110,417	+ 9.3
Finished Gasoline	95,481	103,586	+ 8.5
Natural Gasoline	5,579	6,831	+ 22.4
Stocks, End of Period	126,227	134,527	+ 6.6
(Days' Supply)	55	57	+ 3.6
Finished Gasoline	118,822	126,727	+ 6.7
Natural Gasoline	7,405	7,800	+ 5.3
Demand, Total	205,994	211,574	+ 2.7
(Daily Average)	2,289	2,351	+ 2.7
Exports, Total	11,859	4,797	— 59.5
(Daily Average)	132	53	— 59.5
Domestic Demand	194,135	206,777	+ 6.5
(Daily Average)	2,157	2,298	+ 6.5
DISTILLATE FUEL OIL			
Production, Total	90,045	89,603	— 0.5
(Daily Average)	1,001	996	— 0.5
Percent Yield from Crude	18.2	18.4	.....
Transfers from Crude	766	669	— 12.7
(Daily Average)	8	7	— 12.7
Imports, Total	118	181	+ 53.4
(Daily Average)	1	2	+ 53.4
Change in Stocks	—22,552	—36,681	.....
(Daily Average)	—251	—408	.....
Stocks, Beginning of Period	71,475	75,435	+ 5.5
Stocks, End of Period	48,923	38,754	— 20.8
(Days' Supply)	39	27	— 30.8
Demand, Total	113,481	127,134	+ 12.0
(Daily Average)	1,261	1,413	+ 12.0
Exports, Total	4,477	2,426	— 45.8
(Daily Average)	50	27	— 45.8
Domestic Demand	109,004	124,708	+ 14.4
(Daily Average)	1,211	1,386	+ 14.4
RESIDUAL FUEL OIL			
Production, Total	116,899	105,761	— 9.5
(Daily Average)	1,299	1,175	— 9.5
Percent Yield from Crude	23.7	21.7	.....
Transfers from Crude	1,466	1,385	— 5.5
(Daily Average)	16	15	— 5.5
Imports, Total	14,366	25,101	+ 74.7
(Daily Average)	160	279	+ 74.7
Change in Stocks	— 5,831	—18,937	.....
(Daily Average)	—65	—211	.....
Stocks, Beginning of Period	64,021	60,193	— 6.0
Stocks, End of Period	58,190	41,256	— 29.1
(Days' Supply)	38	24	— 36.8
Demand, Total	138,562	151,184	+ 9.1
(Daily Average)	1,540	1,680	+ 9.1
Exports, Total	3,210	3,478	+ 8.3
(Daily Average)	36	39	+ 8.3
Domestic Demand	135,352	147,706	+ 9.1
(Daily Average)	1,504	1,641	+ 9.1
LUBRICANTS			
Production, Total	11,529	11,206	— 2.8
(Daily Average)	128	125	— 2.8
Percent Yield from Crude	2.3	2.3	.....
Imports, Total	.....	.....	.....
(Daily Average)	.....	.....	.....
Change in Stocks	+1,088	+81	.....
(Daily Average)	+12	+1	.....
Stocks, Beginning of Period	9,843	9,219	— 6.3
Stocks, End of Period	10,931	9,300	— 14.9
(Days' Supply)	94	75	— 20.2
Demand, Total	10,441	11,125	+ 6.6
(Daily Average)	116	124	+ 6.6
Exports, Total	3,223	3,082	— 4.4
(Daily Average)	36	34	— 4.4
Domestic Demand	7,218	8,043	+ 11.4
(Daily Average)	80	90	+ 11.4

When Government SPENDS

John Citizen PAYS

TAXATION is the drafting of the people's money—the money for which the taxed people have labored. Taxes are high for one very good reason: We have to pay for everything the government—federal, state or local—does for us. The more the government does for us, the more we have to pay. The more the government wastes, the less we get for what we pay.

Suppose that, instead of taxing the people's money, which is indirectly taking part of the citizen's labor, the government took the labor itself. Suppose that, instead of having to set aside for taxes part of what we earn, each of us gave the equivalent in work. Suppose next Monday, a million of us turned up on the tax-job. Each would be given a shovel. Under the direction of a lot of tax collectors, we'd dig a ditch. All day long we'd work. Next day we'd show up, get our shovels and, under the same direction, fill up the ditch. Long before the close of that second day, the entire million of us would be mad—good and mad. We'd descend upon those tax collectors and demand that they put an end to the ridiculous squandering of our labor. We'd get action!

Why, then, don't we demand that silly, wasteful expenditures of *money* earned by our *labor* be stopped?

One reason is that a lot of clever talkers are able to convince many people that, while two and two equal four, 2 billion plus 2 billion equal 7 billion, 70 billion or what have you! Here are examples of the things you are asked to believe:

A huge federal budget is fine for everybody because it puts lots of money in circulation.

Debts that we owe ourselves don't matter.

What everybody owes, nobody has to pay.

While deficits are bad for people, they are good for governments.

We can spend our way out of financial difficulties.

The only thing that can be done about huge public expenditures is to raise taxes.

The government itself has nothing it does not get from its people. What you get from the government must be paid for in taxes, however well concealed they may be. You can't use the money you pay in taxes for anything else you may want.

For example, your wife may need a new winter coat. The money that would have paid for it went in taxes that helped to pay for a handsome, but not really necessary, post office in sparsely populated Squirrel Corners.

Plenty Plaques

Your boy may want a bicycle. You had the money for a little while, but you had to pay it out in taxes. That part of your taxes helped to put a bronze plaque on the new bridge over Squirrel Creek. So you tell your son you can't afford to buy him a bicycle now. You can't, but you did afford that plaque!

Your next door neighbor can't have his house painted this year. The money with which he could have paid a painter went in taxes to help a bureaucrat have a secretary with 3.6 typewriters!

If the problem were simply one of waste, it would be difficult enough. Actually, high taxes result partly from asking the government to do for us too many things we ought to do for ourselves. Even if the government did them efficiently—which only too often it does not—taxes to pay for them would still be too high.

What can be done about these growing taxes? What can be done about the constant addition to the long list of government expenditures that results in more and move taxes? Americans have the right to grumble and the right to get angry. If they grumble loud enough they can make a lot of federal, state and local lawmakers realize that citizens are sick and tired of paying ever-increasing taxes.

The cartoonists' symbol for the taxpayer is a harassed little man wearing a loose-fitting barrel. We smile indulgently, but few of us identify ourselves with the character. Indeed, in the whole topic of taxes we too frequently find a note of hilarity. As the March 15 federal income tax deadline approaches we tell each other tax jokes! Actually, there's nothing in taxes to laugh about. The whole subject of taxation is "as funny as a crutch."

No one likes to pay taxes, but there is relatively little taxpayer-resentment, even of obviously excessive taxation, because very few of us are fully tax-conscious. The darkness below the surface of American economic life is alive with hidden taxes. They teem and multiply. They mean increased costs for virtually every item of living.

Taxation analysts, trying to induce shock in taxpayers, cite instances such as these:

There were 114 different taxes in the hamburger steak you had for lunch. There were 164 taxes molded into the cake of soap you used today. The necktie you wear carries a burden of 67 different taxes.

Or take the case history of the egg, as recorded in the files of the Tax Foundation, a public research group. Starting at scratch—that is, literally, at the place where the hen feeds—the process of producing the egg on a Minnesota farm is studied for hidden taxes and pursued through delivery to a Chicago grocery. Something like 100 taxes are involved in the transactions. Only a fraction of these are federal taxes; the majority are state and local taxes. But taxes they are. Ultimately, of course, the consumer pays them.

There is a still more brutally realistic approach: It is estimated, conservatively, that the average working citizen annually

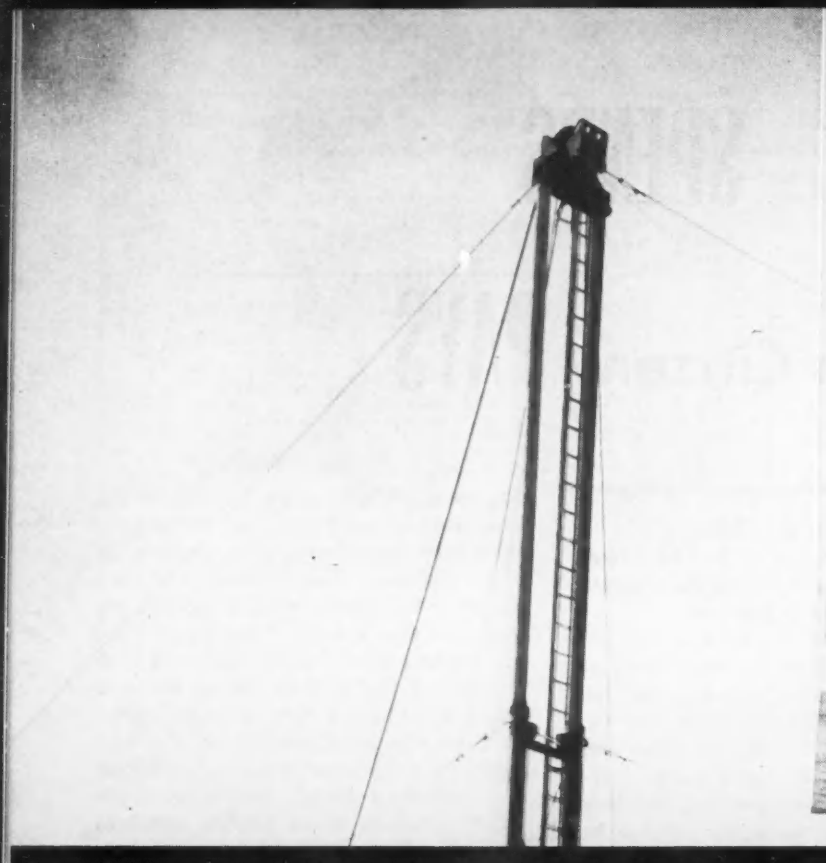
HIDDEN TAXES

• In addition to income taxes, the U. S. Government collects vast taxes in many hidden ways.

• Last year, for example, the average American paid such taxes as $35 for smoking, $13 for using his telephone, $10 for going to the movies, $6 for riding on trains and buses, $48 for miscellaneous purchases, $22 for operating an automobile, $400 in hidden taxes if he bought the average $1500 car, $50 in taxes for gasoline and oil, and $100 to support more than 2 million federal payrollers.

• In all, the average American paid the government more in taxes than he paid for food.

Reprinted from *The Flying Red Horse*, published by The Socony-Vacuum Oil Company.



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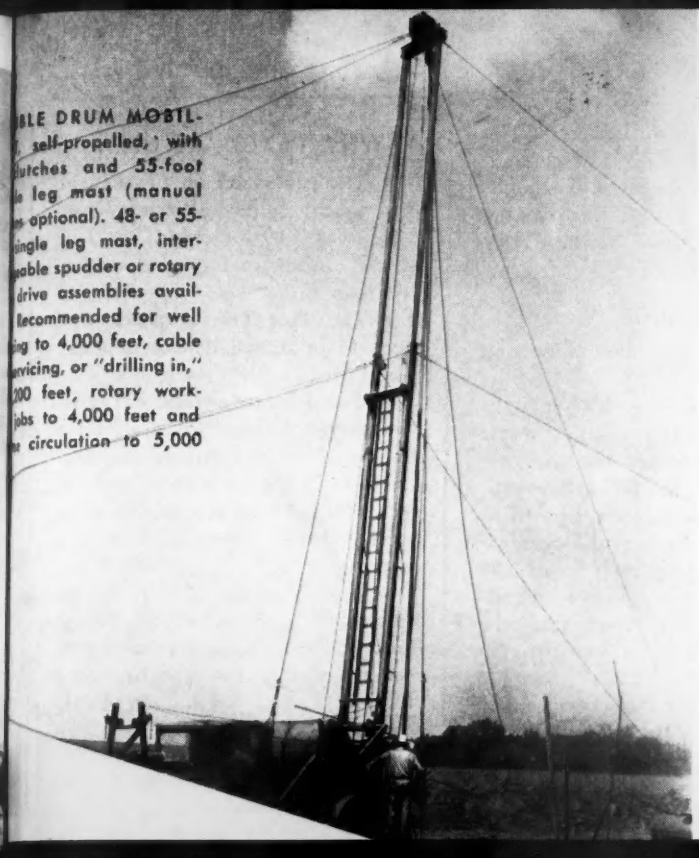

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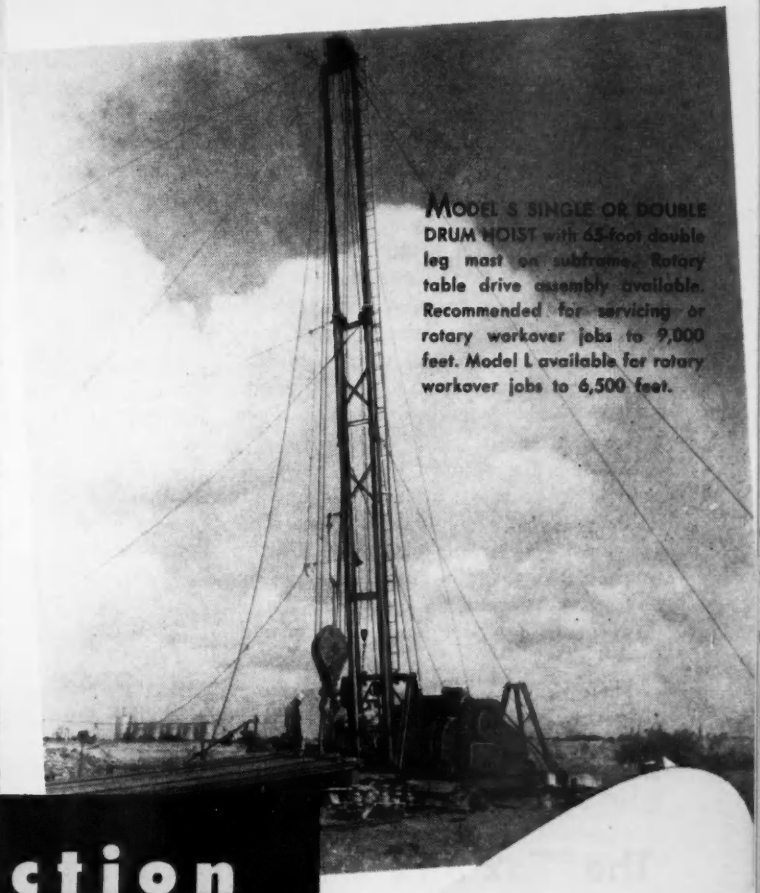

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hands over to the federal government in taxes an amount equivalent to 47 days' pay, and to state and local governments an amount equal to 14 days' pay. That's a total of 61 days, and that's striking pretty close to home.

Even this view is not always persuasive, because the withholding of income taxes at the source has proved relatively painless to most taxpayers. It is money the average citizen never sees or feels, and, therefore, it is regarded without passion. Given a chance, though, he conceivably would develop a deep attachment for it!

Consider then, "open taxes," some of them masquerading under the name of "luxury taxes:" You pay a 20 percent tax when you buy tickets to the theatre or the movies, the circus, the rodeo, or any sporting event, on light bulbs, jewelry, cosmetics, toilet goods, luggage and fur coats.

There is no escape, for, when you try to get away, you pay a 15 percent tax on train, plane and steamship fares. You also pay 15 percent if you phone or telegraph or buy sporting goods. Taxes are a mere 10 percent on refrigerators, musical instruments and record players. The tax on your new automobile is 7 percent. On new parts, it is 5 percent. Throughout the nation taxes on gasoline average more than 6 cents on a gallon. They add up—fast.

The Solution

What can be done to dam the rising flood of taxes?

The answer seems to be clear enough: economy and the elimination of waste and duplication. Congress has the corrective blueprint for the federal government, having received it last spring when the bipartisan Commission on Organization of the Executive Branch of the Government, headed by former President Herbert Hoover, completed the most exhaustive study of our government ever made.

Twenty-four groups of researchers, called task forces and comprising 300 specialists, turned in a 2-million word report with recommendations for legislation that, it has been estimated, would save the taxpayers between $3 billion and $4 billion annually. The commission's finding were startling:

In the past 20 years, it noted, the cost of federal government had jumped from $4 billion to $42 billion and the government's civilian employment from 600,000 to 2,100,000. The government was taking $1 out of every $5 of the national income; the national debt had risen to $7000 per family. The Executive Branch had grown to a hodge-podge of 1812 departments, agencies, boards and bureaus. The list could go indefinitely through all the major departments and agencies.

The commission's report received the blessing of President Truman, who agreed with Mr. Hoover and those associated with him in the study of government costs that remedial legislation ought to be passed. Congress has already passed 20 percent of the suggested legislation.

Meanwhile, in June, the commission ceased to exist. The work of educating the taxpayers in the common sense of fighting the battle for economy and elimination of wasteful effort was taken over by the Citizens Committee for the Hoover Report, headed by Dr. Robert L. Johnson, President of Temple University. This committee is non-partisan and is interested in one thing: helping people to see the light.

If Americans grumble about taxes, here's a chance to grumble in a big way and make it count. If enough people get angry enough to make their voices heard as they demand, "Stop Wasting Our Money," wasteful expenditures can be curbed and taxes will come down. But not until then!

WHY TAXES ARE HIGH

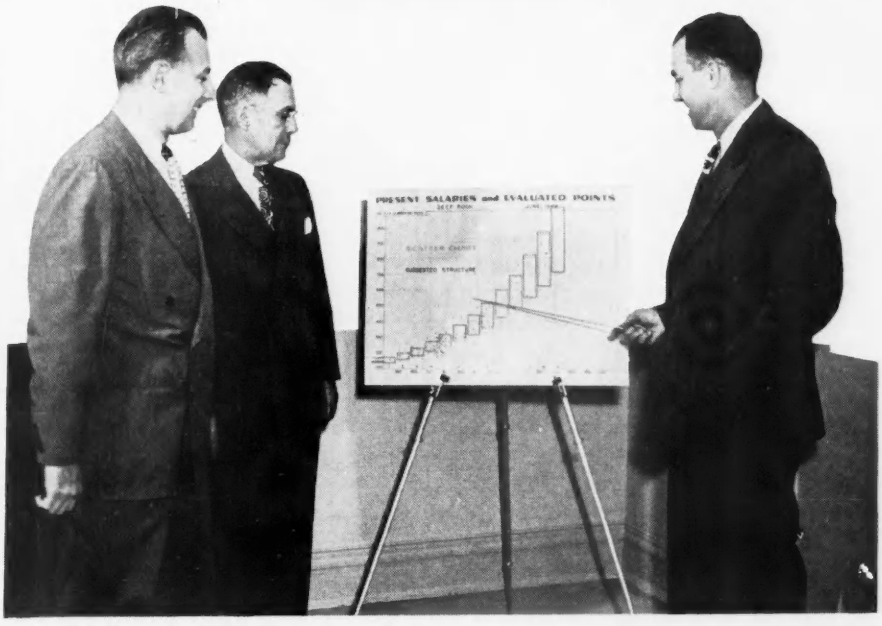
- **The paperwork on 1½ annual government purchase orders costs more than $10 an order, but half of the orders are for items costing less than $10.**
- **The Post Office spends 2½ cents to print and deliver a penny postal card.**
- **Two different government agencies surveyed construction sites for dams half a mile apart on the same river at an approximate cost of $250,000 for each survey; but their estimated costs were $76 million apart.**
- **The Veterans Administration employs four times as many insurance workers per policy as private companies do, but requires four times as long to pay a veteran's insurance death claim as does a private company.**

The "Tax Bite"—what it Adds to Living Costs

Reprinted from the *Journal-American*, January 10, 1950

Job Evaluation—1950 Model

By JAMES H. WESTBROOK
Manager, Personnel and Industrial Relations Division
Deep Rock Oil Corporation, Tulsa



Salary committeemen, Controller A. R. Bell, Jr., Secretary-Treasurer O. O. Kerr, and Personnel and Industrial Relations Manager J. H. Westbrook inspect job evaluation chart.

SALARIES and wages represent the incentive for working. In addition, a salary indicates the measure of importance which an employer attaches to a job. And the relation of an employe's salary to those paid to his associates can be the cause of great satisfaction or considerable unrest and discontent. Thus, the determination of wages and salaries in any industry represent not only a complex problem, but an outstanding opportunity to increase productivity and improve morale.

Fortunately, industrial engineers and personnel administrators have been working intensively toward a solution of salary problems since World War I. Their work has resulted in the development of a management tool called "Job Evaluation"—a tool that enables the modern management executive to apply to the salary problem the same kind of precise measurement and scientific analysis that is used to solve other management problems, such as those encountered in construction, drilling, exploration, and marketing.

Lest strange terminology lend an air of mystery, let us explain right now that job evaluation is simply a technique for comparing jobs in order to arrive at their relative worth. While the installation of a job evaluation program requires the direction of an experienced administrator, the functioning of a completed program is simple enough to be understood by everyone, and therein lies the key to its success. Once the veil of mystery is torn from the method of determining salaries, one of the greatest causes of unrest and discontent is banished.

PROPER DETERMINATION of wages and salaries is necessary to assure for a company employes that are satisfied and productive in their work. Through job evaluation, a technique for comparing jobs in order to arrive at their relative worth, modern management can apply to the salary problem the same kind of precise measurement and scientific analysis that is used to solve other management problems. Four methods of job evaluation, here described, have proven themselves through extensive use, and a company may find one of these or a combination of them desirable.

Early in 1949, Deep Rock Oil Corporation recognized the need for placing wage and salary administration on a sound enough basis to insure equitable compensation to all employes. As a first step in this direction, President W. H. Garbade appointed a salary committee consisting of the controller, the treasurer, and the manager of personnel and industrial relations to study the problem and recommend a solution. These appointments reflect a vital principle in salary administration, namely that it merits attention from the highest echelon of management. The conclusions of a salary committee composed of members from top management of a company inevitably are given more weight by other management personnel than if the recommendations were the work of outside consultants or individuals with lesser business experience.

The subsequent development of the job evaluation program at Deep Rock by the salary committee is an example of the work done successfully with this management tool. The exact application will vary to fit the circumstances of each company, but the principles will remain the same for all organizations.

The Deep Rock committee found that, while extensive work has been done for many years in the field of job evaluation, there is still no set package which

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can be purchased to cover the requirements of all companies. The committee also found that in spite of the tremendous amount of literature on the subject, there are only four methods of job evaluation which have proven themselves through extensive use. These four methods are ranking, classification, point rating, and factor comparison. Without going into great detail, ranking can be summarized as the comparison of jobs according to their relative importance in an organization, using over-all judgment of several members of management. Classification involves separating all jobs respective to their requirements and functions in a company. The point rating plan considers the requirements of jobs according to numerical values assigned to common job characteristics, and factor comparison consists fo measuring the characteristic factors of one job against those of another.

Of these four recognized methods, the point rating plan and factor comparison are most widely used, although various degrees and combinations of all the methods are adaptable to the solution of certain problems. The committee at Deep Rock chose the point rating method because it is simpler to apply and is easier to explain.

The steps taken to complete the development and installation of the job evaluation program at Deep Rock consisted of the following:

1. Meetings were held with all management personnel to outline the problem and the proposed solution. At these meetings all management personnel were given a complete picture of how the work would be done. All questions were answered frankly and in detail.

2. Following the management sessions, a series of meetings were held with all employes who were to be included in the program. In its initial phase, the program was planned to cover only the clerical and supervisory personnel in the Tulsa general office. In these meetings, also, a complete picture was given, with all questions being answered with complete frankness. The importance of these preliminary meetings can hardly be overemphasized. They proved to be the best means of removing the suspicion and doubt surrounding the new program, and helped gain the cooperation among employes necessary to the development of the job evaluation system.

3. At this point, job analysis was undertaken. To analyze each job, questionnaires were distributed to all personnel involved, asking them about the duties and responsibilities of their positions and the amount of education, experience and training necessary to perform the work. From these answers, the Personnel Division prepared job description sheets which listed the general duties and responsibilities of each position. These descriptions were then checked and approved by the individuals and supervisors and their department heads. When completed and approved, the descriptions formed the basis for evaluating the various jobs.

4. Following completion of the job analysis, the point rating plan was applied. Each job was broken down into nine factors with a rating table for each one. Each rating table consisted of six different degrees with each successive degree being assigned a specific number of points greater than those assigned to the preceding degree. These differences in degrees made it possible to measure the value of, say, education needed for one job as compared with the value of education required for another. For instance, Figure 1 shows that a stenographer's position requiring high school training would receive 95 points for education, while an accountant's job requiring a college degree would receive 138 points for education. It was also made possible to receive points for education by substituting actual experience.

With these rating tables, the supervisors and department heads, along with the Personnel Division representative, compared all Deep Rock jobs and allotted points for the other factors in the same way as explained in the education example, with every position receiving a total value somewhere between 300 and 1000 points.

5. Having established the relative importance of the positions inside the Deep Rock organization, salary ranges were established as follows: The salary committee reviewed the evaluations and selected 24 representative jobs, a third of which had point values in the lower range, and a third in the middle range, and a third in the top range of point values. Descriptions covering these jobs were then sent to 17 other oil companies in the Tulsa area to compare their salaries with Deep Rock's. When this comparative information was returned, the committee prepared charts showing trend lines for the lowest and highest salaries

Deep Rock Oil Corporation

JOB DESCRIPTION

Present Title: Clerk-Stenographer — **Proposed Title:** Same

Division: Land and Exploration — **Approval:** Division Head

Department: Land — **Approval:** Department Manager

Section: Lease Records — **Approval:** Supervisor

Location: Tulsa Office — **Prepared by:** ALS **Date:** 5-5-49

DUTIES AND RESPONSIBILITIES

A. General Function:
To take and transcribe dictation pertaining to the work of the section and perform related clerical duties.

B. Basic Job Requirement:
High School graduate with shorthand and typing.

C. Specific Duties:
Under the immediate supervision of the Lease Record Supervisor, takes and transcribes dictation pertaining to title questions, working agreements with other companies, lease terms, and general inquires from land owners and brokers. Types related forms and legal instruments. Numbers, labels, and plats lease files. Prepare cross index reference cards and posts file numbers in lease file register. Files lease folders and posts changes or adds new material. Rearranges files as required.

Factor Analysis

TITLE: Clerk-Stenographer

Factor	BASIS OF RATING	Degree	Point Value
1. Education	High School graduate. Shorthand and Typing	C	95
2. Previous Related Experience	One year general clerical experience, in lease record work desirable, but not essential.	B	70
3. Training Period on Job	Six months to learn filing system, become familiar with procedure and forms and get to know Company personnel.	D	57
4. Physical Effort	Moving files, handling lease folders, and plat books. Use of typewriter. Standing while filing.	B	23
5. Mental Effort	Variety of detail where accuracy of facts is an important item in protecting company interests. Time elements require continual effort.	C	54
6. Initiative	Work follows detailed procedures or specific instructions.	B	63
7. Judgment	Limited to arranging details of work assignment.	A	45
8. Creative	Not a basic job requirement.	A	25
9. Contacts with	May greet visitors in office, contacts Brokers to obtain or give information on lease agreements.	B	58
	Total	....	490

EDUCATION RATING TABLE

Degree	Position Requirements	Point Value
A	Eighth Grade education	53
B	Two years High School	74
C	High School graduation	95
D	High School, plus two years specialized training	116
E	College graduation	138
F	College, plus specialized graduate degree	160

Definition: The amount of formal or academic training which can be used to significant advantage on the job.

Explanation: This factor seeks to appraise the basic education and specialized skill or knowledge required by the average employee in performing required job duties.

In evaluating jobs under this factor, consider the minimum amount of formal schooling necessary for satisfactory job performance.

Chart I

Satisfactory job performance is defined as that done by the average employee after an average period of instruction and/or training.

FIGURE 1.

being paid in each job classification, as well as an over-all average as shown in Figure 2.

To complete the comparison, the chart was divided into 12 salary grades which fell within the limits of the averages computed for the community. Thus, positions with point values between 300 and 340 points were assigned to Salary Grade 1, 345 to 385 points to Salary Grade 2, and so on up through 12 grades.

The five point differences between each salary grade assured that no job salaries would be determined by less than five points. In those cases where the point value fell in between, the position was considered on an individual basis and placed in the higher or lower salary grade on the basis of its actual similarity with other jobs, in addition to its characteristic factors.

6. Meetings were held again, first with management personnel and then with all employes, in which the development of the program was explained in detail, and salary adjustments were announced to be made promptly in accordance with the plan.

7. Salary adjustments then were made as follows: All persons receiving less than the minimum salary of the range to which their job had been assigned were immediately raised to the minimum for their salary grade, but those persons who were receiving more than the maximum of their job salary range continued to receive their present salary, until all cases where over-payment was indicated could be considered on an individual basis to determine whether or not the employe could be transferred to work of greater responsibility where the higher salary would be warranted. If such transfers could not be effected, the committee decided that these out-of-line payments would have to be settled through retirement and normal personnel turnover. It is interesting to note that in the case at Deep Rock, the amount of over- and under-payments were approximately equal, and thus, there was little immediate cost involved in the installation of job evaluation.

Of course, completion of the steps enumerated above does not mean that the job evaluation program will run itself without further attention. In addition to extending job evaluation to other areas of the company operation, it will be necessary for the salary committee to continue functioning to keep job descriptions up-to-date, to make necessary modifications in evaluations as jobs change in duties and responsibilities, and to make certain that the Deep Rock salary structure remains in proper relation to the community and industry.

Applying the Plan

Job evaluation has proven to be an effective tool for Deep Rock, but for other oil companies who are considering its application, the following observations are offered:

1. Job evaluation is limited to determining only the worth of a job. It does not concern itself with the performance of the individual on the job, nor is it a panacea for all personnel problems.

2. Top management attitude must be conducive to accepting the final factual results. If job classifications and salary schedules are determined through careful objective analysis and then adjusted because they do not fit the pattern employes or members of management think they should, then no job evaluation program can remain the accurate management tool originally sought by the company. Changes in established salary ranges must, of course, be made but only when job duties and responsibilities or the salary markets change sufficiently to warrant such adjustments.

3. Selling the program has much to do with its effectiveness in increasing productivity and raising morale. Therefore, the meetings described above are important enough to be led by top management representatives. Unless all suspicion is dispelled and enthusiastic cooperation enlisted, the job evaluation program cannot be fully effective.

4. Unless someone in a company's staff has had considerable experience elsewhere in the application of job evaluation, it is necessary either to employ such a person or retain the services of a competent consultant.

Price tags placed on jobs through the use of job evaluation may turn out to be the same price tag which competent executives have already given to the job today, but even so job evaluation will put a company in position to discuss that price tag with employes on a straight forward systematic basis without embarrassment. Job evaluation is a 20th century answer to a 20th century problem.

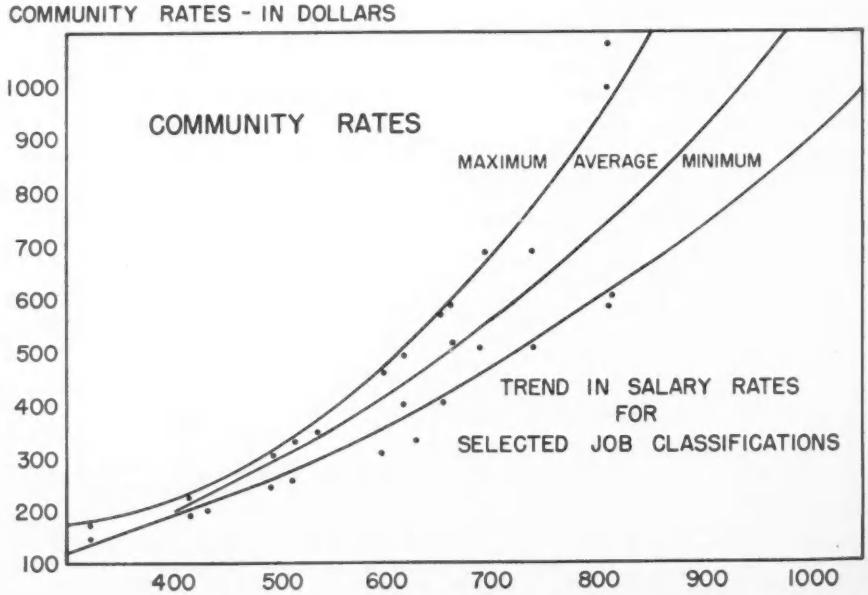
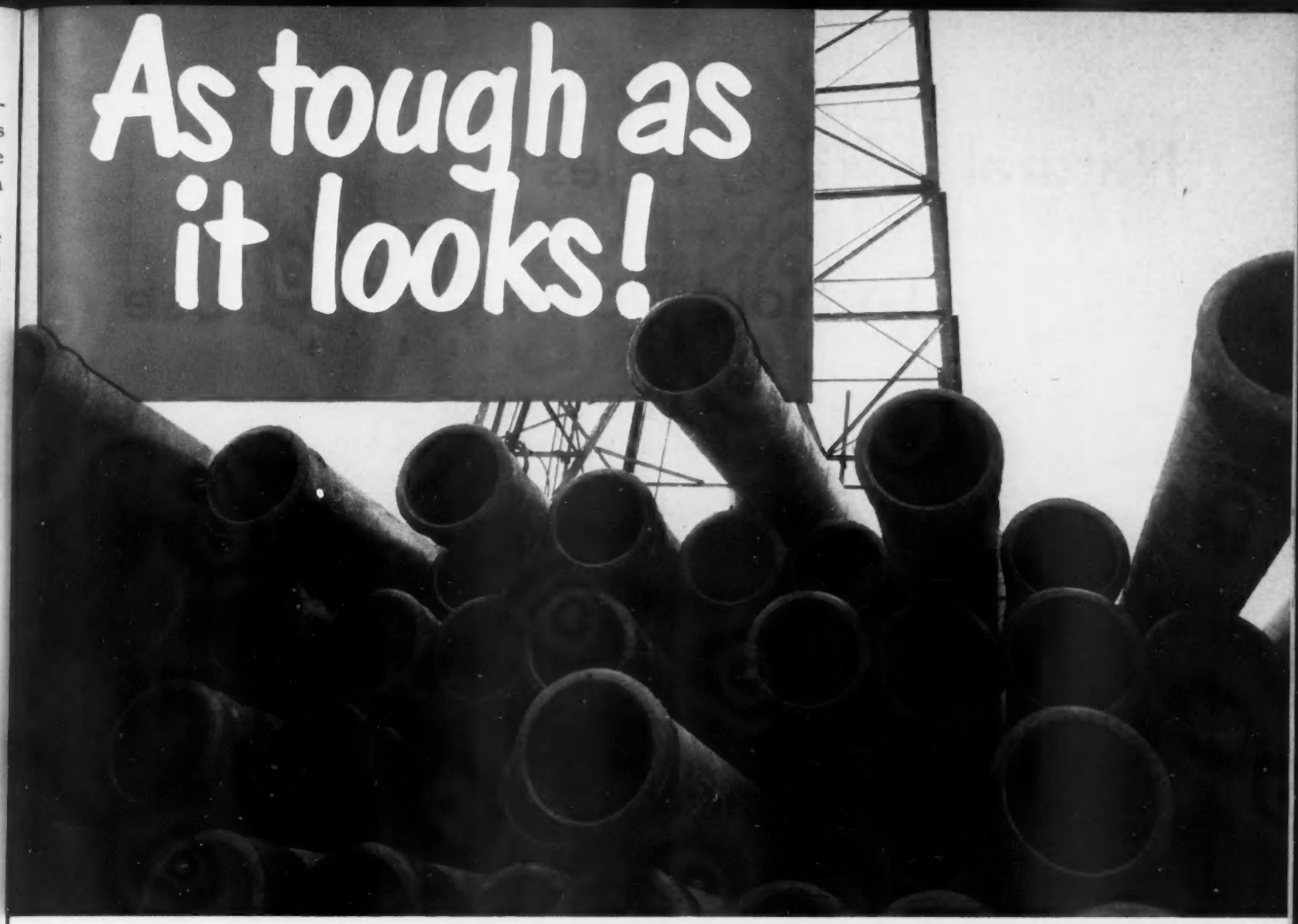


FIGURE 2.



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UNITED STATES STEEL

Natural Gas Sales To Hold Down Oil Use

By ALBERT J. McINTOSH
Economist, Socony-Vacuum Oil Company, Inc., New York

PRESENT AND FUTURE status of natural gas in relation to liquid fuels is discussed in this article, which is a condensation of a highly significant paper presented before Western Petroleum Refiners Association at San Antonio, Texas, March 27, 1950, under the title, "Fuel Oil Markets—Past and Future." The original paper embodied numerous other charts and tables in addition to those presented here, and represented probably the first detailed study of the subject to be disclosed publicly.

PRODUCERS of oil and gas, as well as refiners, henceforth will be materially affected by important changes now taking place in consumption of the different major fuels, including especially the current vast expansion of natural gas use.

A highly desirable fuel, natural gas is in the process of taking over large existing and potential markets, thereby reducing markets for fuel oils as well as coal.

Although use of fuel oils may continue to increase nominally, increases will be slowed materially by competition from natural gas, and sales may increase only 1 percent during the next three years. (A gain of perhaps 13 percent for distillate may be largely offset by declines of 8 percent for residuals and 2 percent for kerosine.)

With gas use continuing to increase relatively sharply, companies and operators with significant natural gas sales relative to their oil business will benefit from those sales and tend to offset some of the adverse effects to their oil business.

Planned expansion in the natural gas industry is so great that projects to be completed in the next three years will supply markets equivalent to 518,000 barrels per day of fuel oils. This includes additions of 283,000 barrels next year, 166,000 in 1952, and 69,000 in 1953. Only about one-half of the new market equivalent to 518,000 barrels of oil per day to be supplied by natural gas will displace oils, and the other half will displace coal. However, the part displacing oils will largely cancel out increases that otherwise ordinarily would occur in consumption of fuel oils. As previously indicated, whatever increases occur in use of distillate and fuel oils will be practically offset by losses in residual fuels and kerosine. The natural gas will be competing most strongly with coal and residual fuel oil, considerably with kerosine, and appreciably with distillate fuel oils.

Present plans of natural gas pipe line companies indicate a heavy impact of natural gas competition during the coming year and some tapering off thereafter. However, plans for new pipe lines may be expanded and create more market for natural gas than is now indicated for the latter part of the coming three-year period, further adversely affecting demand for fuel oils.

In order to allow for inroads of natural gas into the normal markets for fuel oils, the petroleum industry must adjust refinery operations to reduce yield of residual fuel oil and increase yields of gasoline and diesel oil. From the present yield of 44½ percent of fuel oils from crude, there should be a reduction to less than 42 percent by 1953, achieved mainly by lowering yield of residual fuel oil about three percent. To accomplish these changes, gasoline yield should be increased by 1953 to a record high of 46 percent from the present 43.7 percent.

In connection with yields and refinery operations, the industry also should pay increased attention to the effect of weather on oil use and more effectively

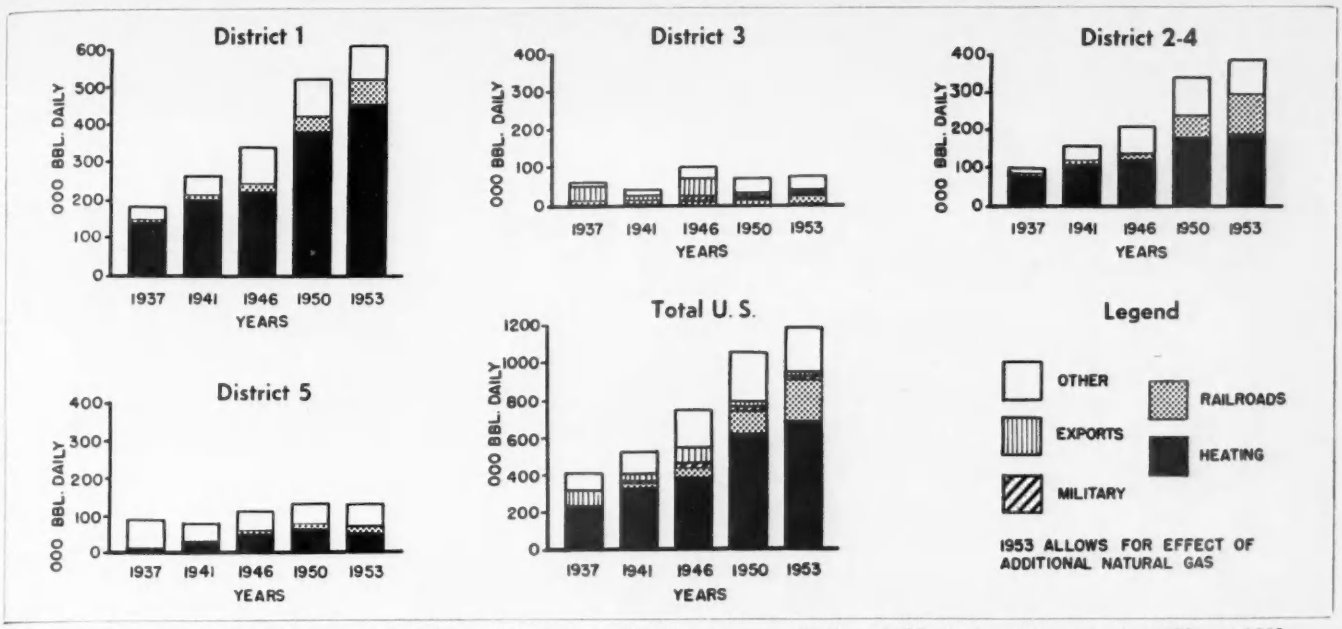
TABLE 1
Distribution of Major New Natural Gas Supplies in District 1 (East Coast Area)
Incremental Gains in Average Delivery Rates

AREA	NATURAL GAS (Millions Cu. Ft. Daily)				FUEL OIL EQUIVALENTS (Thousands Barrels Daily)			
	1951	1952	1953	Total	1951	1952	1953	Total
New England (a)	....	120	100	220	....	22	18	40
New York (b)	285	....	....	285	51	....	....	51
New Jersey (b)	102	....	....	102	18	....	....	18
Pennsylvania (b)	128.5	....	....	128.5	23	....	....	23
Total	515.5	120	100	735.5	92	22	18	132
West Virginia (c)	12.5	....	....	12.5	2	....	....	2
Md., D. C., Virginia (d)	50	10	10	70	9	2	2	13
Virginia and Carolinas (e)	100	175	....	275	18	31	....	49
Georgia, South Carolina, etc. (f)	10	35	....	45	2	6	....	8
Total	172.5	220	10	402.5	31	39	2	72
TOTAL*	688	340	110	1,138	123	61	20	204

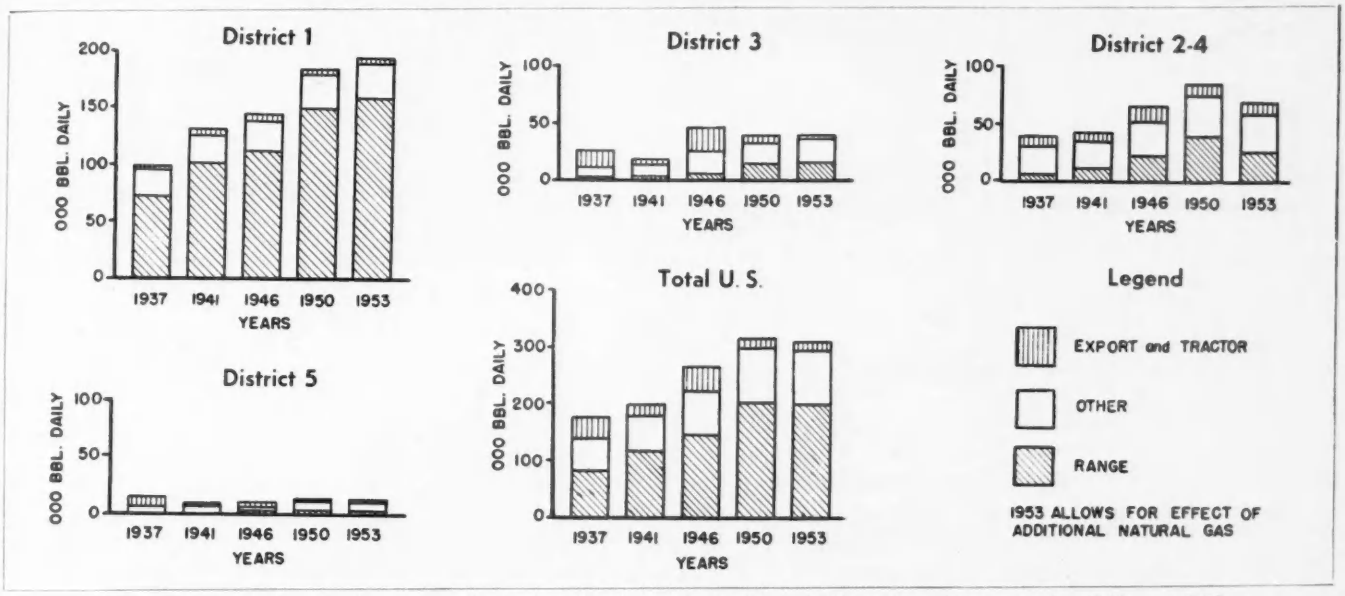
(a) Either Tenn. Gas-Transcontinental or Texas Eastern. Assume completion in 1st half of 1952.
(b) Assume Transcontinental is approved for 505 and starts delivery beginning of 1951. Tenn. Gas will bring in 333 additional, exclusive of quantity supplied New England. Texas Eastern will bring in 258 additional, exclusive of quantities supplied New England.
(c) Tenn. Gas and Texas Eastern.
(d) Probable average delivery of Atlantic Seaboard, Virginia Gas Transmission line.
(e) Virginia and Carolinas. May be from Piedmont line or competitors. Completion by mid-1951.
(f) Southern Natural Gas: Assume 150 delivered into Georgia through present facilities. Filed for additional 109 capacity, assume 35 of this in District No. 1 in 1952.
* Based on following line capacities in 1953 (Excl. 220 for New England):

Transcontinental	405	
Atlantic Seaboard	197	
Piedmont (or competitors)	275	
Texas Eastern	740	Only part of this enters District No. 1.
Tennessee Gas	1,060	Only part of this enters District No. 1.
Southern Natural	529	Only part of this enters District No. 1.

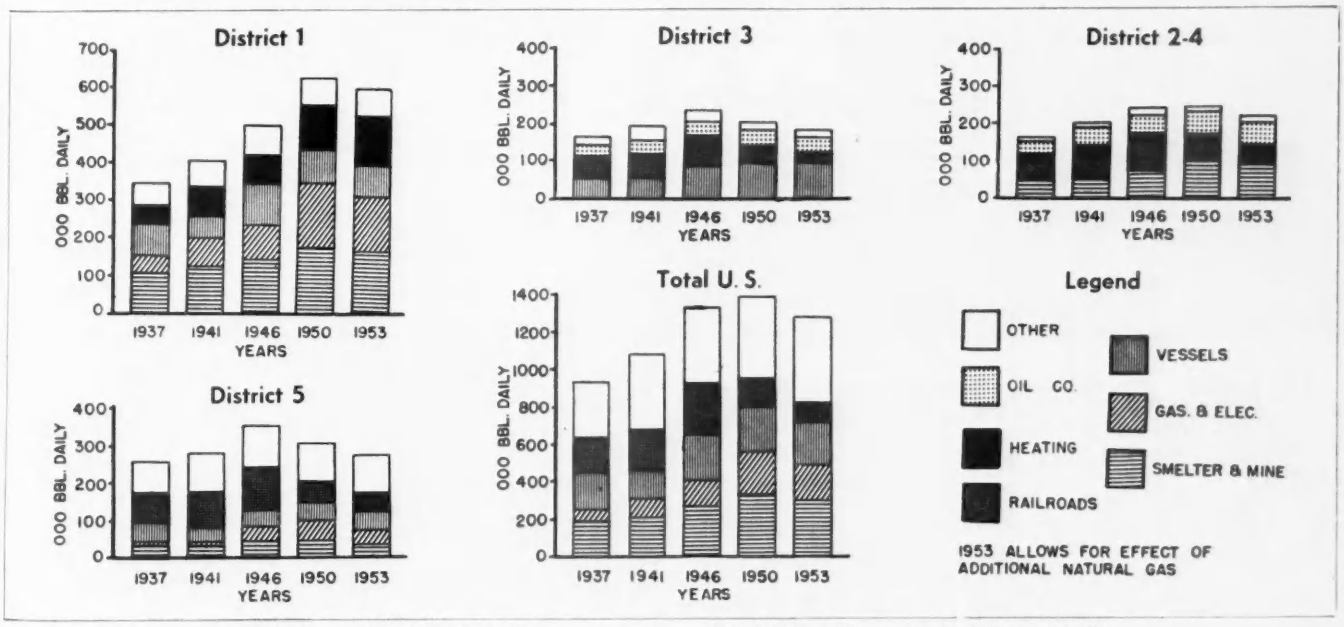
(Piedmont plans to increase capacity to 365 by 1955).



Principal uses of diesel and distillate fuel oils by districts (excluding No. 1 range oil). Years 1937-41-46 and forecasts for 1950 and 1953.



Principal uses of kerosine by districts (excluding No. 1 range oil). Years 1937-41-46 and forecasts for 1950 and 1953.



Principal uses of residual fuel oil by districts. Years 1937-41-46 and forecasts for 1950 and 1953.

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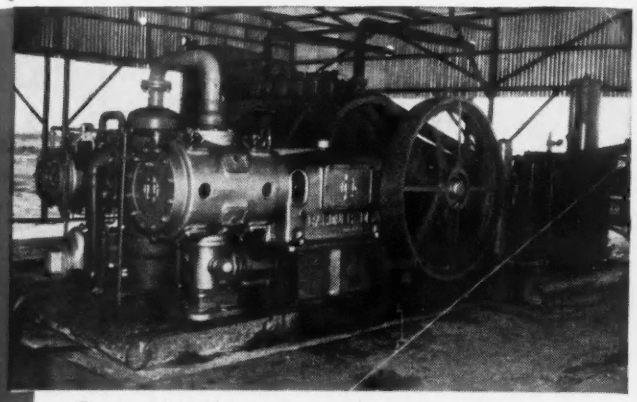
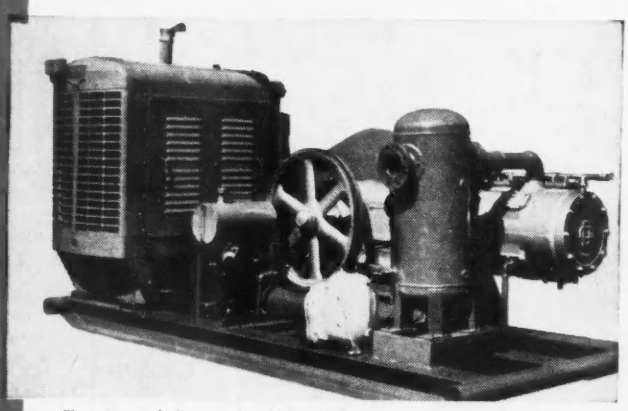
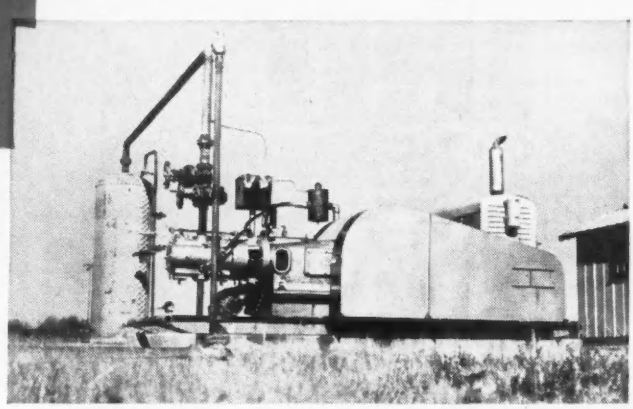


Gas engine driven 12 and 6 x 13 compressor for re-pressuring service.

Engine driven model ABE for re-pressuring or booster service.



Engine driven 8 x 9 gas booster compressor.



Engine driven 5½ x 9 booster compressor.

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use the "degree-day" system to gauge consumption. Consumption of all petroleum products during the past winter up to March 1 in the U. S. was about 26 million barrels below normal because of unseasonable warmth. Under the "degree-day" system, one degree colder than normal for a given date is equivalent to an increase of 57,100 barrels in amount of fuel oils needed, and one degree warmer means that much less consumption. Liquefied petroleum gas similarly is affected to extent of 6000 barrels a day.

Accompanying charts show past and projected future trends of consumption of the different kinds of fuel oils, by principal uses, by major districts of the country, and for the U. S. as a whole. Data for 1950 are forecast on basis of normal weather the rest of the year and trends now in evidence. Data charted for 1953 allow for the anticipated effect of increased marketing of natural gas upon oil consumption.

Chart data on diesel and distillate fuel oils show probable further increases in U. S. consumption of those products in spite of natural gas. Major markets for those oils are District 1 (East Coast) and Districts 2 and 4 (Central and Rocky Mountain states), while markets are smaller in District 3 (Gulf Coast states) and District 5 (Pacific area). Heating oil use is expected to continue increasing in District 1, despite natural gas, and may show further limited increases in Districts 2 and 4. Materially responsible for a relatively favorable outlook for demand for oils of this group are expected further material increase in use of diesel oils for locomotives by railroads in all sections of the country.

U. S. kerosine use in 1953 may be slightly lower than in 1950, as shown on the charts, due in part to competition from Liquefied petroleum gas, especially in Districts 2 and 4, as well as increased use of natural gas. Helping to sustain kerosine demand, however, will be some increase in use for ranges in District 1, despite wider natural gas use.

Residual fuel oil will be affected more than other oils by natural gas competition. Use in 1953 is expected to be less than in 1950 in all districts, due especially to reduced consumption by railroads, gas and electric utilities, and smelters and mines.

Significance of natural gas competition is emphasized by these charts, as indicated unfavorable trends of the next three years contrast with some sharp increases in oil use in recent years. Since before the war, consumption of kerosine and light fuel oils increased rapidly until recently, the estimates for 1950 showing increases over 1941 by 60 percent for kerosine and 100 percent for diesel and distillate oils. This compares with increases of 42 percent for gasoline and only 28 percent for residual fuel oil. During 1949 kerosine and distillate fuel oils showed up poorly, even after adjusting figures to consider unusually warm weather. Gasoline continued to increase normally, and residual fuel oils kept about even with 1948.

All the known additional major natu-

TABLE 1-A

Distribution of Major New Natural Gas Supplies in Districts 2 and 4 (Central and Rocky Mountain States)

Incremental Gains in Average Delivery Rates

AREA	NATURAL GAS (Millions Cu. Ft. Daily)				FUEL OIL EQUIVALENTS (Thousands Barrels Daily)			
	1951	1952	1953	Total	1951	1952	1953	Total
Ohio, Tenn., Ky. Etc.:								
Texas Eastern Tran. (a)	46.5	....	....	46.5	8	....	....	8
Tenn. Gas Tran. (b)	17.5	....	....	17.5	3	....	....	3
Texas Gas Tran. (c)	84	....	....	84	15	....	....	15
Total	148	....	....	148	26	....	....	26
Chicago-Midwest:								
Tex.-Ill. Nat. Gas P. L. (d)	150	150	100	400	27	27	18	72
Trunkline Gas Supply (Pan. East) (e)	150	100	....	250	27	18	....	45
Michigan-Wisconsin P. L. (f)	74	74	....	148	13	13	....	26
Miss. R. Fuel Corp. (g)	78	....	....	78	14	....	....	14
Total	452	324	100	876	81	58	18	157
West-Central:								
Northern Nat. Gas Co. (h)	130	....	....	130	23	....	....	23
Montana-Dakotas Utilities (i)	10	15	....	25	2	3	....	5
Colorado Interstate Gas Co. (j)	12	....	....	12	2	....	....	2
Total	152	15	....	167	27	3	....	30
TOTAL	752	339	100	1,191	134	61	18	213

(a) Assume expansion to capacity of 740, excluding New England.
(b) Assume expansion to capacity of 1,060, excluding New England.
(c) Assume expansion to capacity of 659, excluding New England.
(d) Project of Peoples, Natural Gas P. L. & Gulf Coast Northern. Initial deliveries mid-1951, none to Piedmont.
(e) Includes part of Pan. Eastern expansion of 102 authorized in 1948 and new line to Ill. estimated to be completed first half 1951.
(f) Line completed October, 1949, capacity 155; requested expansion to 303.
(g) 2nd line to St. Louis completed Nov., 1949 giving combined capacity of 266. Part was used prior to completion. Further expansion to capacity of 375 sought.
(h) Area serviced: Iowa, Minnesota, Nebraska, South Dakota.
(i) From Wyoming to Montana and Dakotas.
(j) From Hugoton, Kansas for Colorado Springs and Pueblo.

TABLE 1-B

Distribution of Major New Natural Gas Supplies in District 5 (Pacific Coast Area)

Incremental Gains in Average Delivery Rates

AREA	NATURAL GAS (Millions Cu. Ft. Daily)				FUEL OIL EQUIVALENTS (Thousands Barrels Daily)			
	1951	1952	1953	Total	1951	1952	1953	Total
Southern California (a)	20	20	....	40	4	3	....	7
Northern California (b)	125	150	100	375	22	27	18	67
Northwest (c)	....	75	75	150	....	14	13	27
Total*	145	245	175	565	26	44	31	101

(a) Showing expansion of Southern California Gas Co. and Southern Counties Gas Co. takings.
(b) Pacific Gas and Electric Co. new "Super-Inch" line.
(c) Assuming a pipe line from Alberta, possibly Westcoast Transmission Corp., Ltd.
* Based on following line capacities in 1953:
El Paso—S. California 405
El Paso—Pacific Gas & Electric 400
Alberta—Portland, Ore. 300 (maximum capacity, with 150 reaching U. S.).

About the Author

ALBERT J. McINTOSH, economist, Socony-Vacuum Oil Company, Inc., New York, N. Y., has been active in work in economics in AIME, API and the Interstate Oil Compact Commission. During World War II he was a member of the petroleum economics subcommittee of the Petroleum Industry War Council.

ral gas pipe lines are listed on three tables, 1, 1-A, and 1-B, which show areas affected and petroleum liquid equivalents of the additional gas supplies. These are lines approved and those projected.

These data show that natural gas equivalent to 518,000 barrels of oil a day will be available in 1953 which was not available in 1950. If all of this were to replace oil, the results would be terrific.

Market research analysts have studied probable effect on liquid petroleum sales from the additional natural gas. Their conclusions, with some modifications, are shown on Table 2. This shows what class of user is expected to turn to gas, and by areas, and the extent of displacement of liquid fuels. Some of this so-called displacement comes about by natural gas securing customers who would otherwise use coal.

For District 1, by 1953, the equivalent of 204,000 barrels per day of additional natural gas will be available, and probably about 120,000 of this will displace liquid fuels. The remainder would displace coal. In District 1, additional natural gas probably will wipe out light gas enrichment oils used by gas plants and cause loss of home heating oils that otherwise would be sold to the extent of 26,000 barrels daily. Other minor losses make up the total loss of 46,000 anticipated for distillate fuel oils. Similar details are shown for other districts and for the three products likely to be affected by natural gas. On an over-all basis for the country, of the equivalent of 518,000 barrels a day of natural gas available in 1953 not available in 1950, about one-half will displace liquid petroleum. Also included is a small quantity of displacement of oils, particularly kerosine, by liquefied petroleum gas.

These quantities have been applied to forecasts for 1953 made originally without allowance for additional natural gas supplies. These results, and comparisons with 1950, are shown in Table. 3.

Between 1950 and 1953, consumption of fuels in District 1 will increase only 5 percent, it is indicated. Distillate fuel oils are expected to increase substantially more than this, but use of residual fuel oil probably will decline, due primarily to loss of heavy gas enrichment oils. In Districts 2 and 4, no more fuel oils will be required in 1953 than in 1950, as a fair increase for light fuel oils likely will be attended by substantial decreases for residual and kerosine, with liquefied petroleum gas as well as natural gas cutting into kerosine markets. In District 5, expected 1953 use of fuel oils is 8 percent under 1950, and each of the fuels likely will show a part of the decline. For the U. S. as a whole, the additional natural gas to be utilized in displacement of oil will practically cancel out increases that otherwise would have occurred during the next three years in consumption of liquid fuels. While distillate and diesel oils are expected to show fairly good increases, those gains likely will be offset by losses in residual fuels and kerosine.

TABLE 2

1953 Forecast of Uses Which May Be Reduced by Increased Supply of Natural Gas

(Thousands of Barrels Daily)

	District 1 (East Coast)	Districts 2 and 4 (Central & Rky. Mt.)	District 5 (Pacific Area)	Total 3 Districts
Distillate Fuel Oil:				
Gas & Electric:				
Diesel	6.8	12.7	1.2	20.7
Other	15.4	5.5	0.2	21.1
Smelters, Mines & Mfg.—Other	23.0	17.8	1.1	41.9
Heating	471.2	226.0	61.1	758.3
No. 1 Range Oil	9.6	27.4	....	37.0
Total Distillate Fuel Oil	526.0	289.4	63.6	879.0
Residual Fuel Oil:				
Gas & Electric	192.3	9.0	59.2	260.5
Smelters, Mines & Mfg.	171.8	104.1	47.4	323.3
Heating	142.5	32.9	26.0	201.4
Total Residual	506.6	146.0	132.6	785.2
Kerosene:				
Range Oil	169.3	41.9	2.2	213.4
Other	31.8	40.3	8.8	80.9
Total Kerosene	201 1	82.2	11.0	294.3
Grand Total Products	1,233.7	517.6	207.2	1,958.5
Reduced Consumption After Allowing for Increased Gas Use—Estimated				
Distillate Fuel Oil:				
Gas & Electric:				
Diesel	5.5	11.1	1.1	17.7
Other	....	2.5	0.2	2.7
Smelters, Mines & Mfg.—Other	20.1	12.9	1.0	34.0
Heating	445.5	188.1	45.3	678.9
No. 1 Range Oil	8.6	19.1	....	27.7
Total Distillate Fuel Oil	479.7	233.7	47.6	761.0
Residual Fuel Oil:				
Gas & Electric	147.3	7.4	37.1	191.8
Smelters, Mines & Mfg.	161.8	90.6	38.4	290.8
Heating	134.7	32.9	25.2	192.8
Total Residual	443.8	130.9	100.7	675.4
Kerosene:				
Range Oil	159.3	24.7	1.2	185.2
Other	30.9	34.6	7.3	72.8
Total Kerosene	190.2	59.3	8.5	258.0
Grand Total Products	1,113.7	423.9	156.8	1,694.4
Total Loss from Added Gas	120.0	93.7	50.4	264.1
Fuel Oil Equiv. of New Nat. Gas	204	213	101	518

NOTE: No additional effect on District No. 3 was assumed.

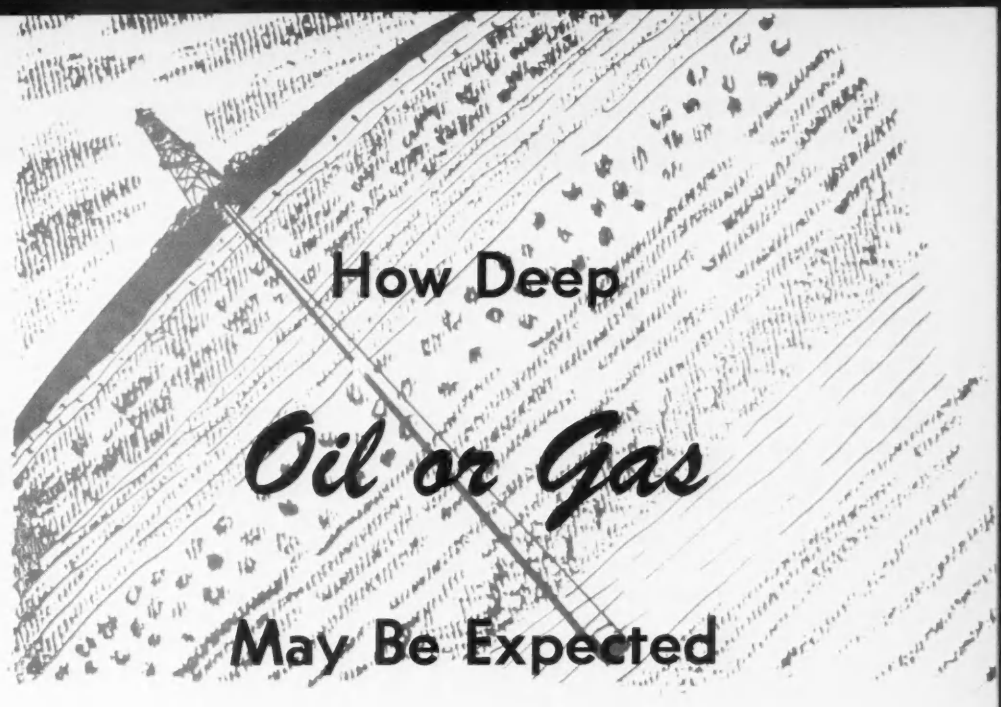
TABLE 3

All Fuels—Changes in Consumption 1953 Vs. 1950 Domestic Plus Export Demand

(Thousands of Barrels Daily)

	District 1 (East Coast)	Districts 2 and 4 (Central & Rky. Mt.)	District 5 (Pacific Area)	Total U. S.
1950 Estimated:				
Distillates	517	339	125	1,045
Residuals	628	249	305	1,386
Kerosene	184	84	11	317
Total	1,329	672	441	2,748
1953 Before Effect of Additional Natural Gas:				
Distillates	649	439	139	1,296
Residuals	661	236	306	1,388
Kerosene	205	90	12	346
Total	1,515	765	457	3,030
1953 After Effect of Additional Natural Gas:				
Distillates	603	384	122	1,178
Residuals	598	221	275	1,278
Kerosene	194	67	9	309
Total	1,395	672	406	2,765
Percent Change 1953 After Gas Vs. 1950:				
Distillates	+17%	+13%	— 2%	+13%
Residuals	— 5%	—11%	—10%	— 8%
Kerosene	+ 6%	—20%	—17%	— 2%
Total	+ 5%	....	— 8%	+ 1%

NOTE: No additional effect on District No. 3 was assumed.



How Deep Oil or Gas May Be Expected

By JAMES S. CLONINGER

The Pure Oil Company, Houston

THE question of how deep oil or gas may occur within the earth has not been of great importance to the oil industry in past years because of the frequent discoveries of relatively shallow new fields. Deep drilling is important at the present time and will assume greater importance in the future as the shallow fields are depleted; therefore, it is important that we know how deep oil or gas may occur.

In this paper, the object is to consider the maximum depth that oil or gas may occur within the earth's crust. No attempt will be made to classify such deposits as commercial or noncommercial and neither will the mechanical and economical problems of drilling to and producing such hydrocarbons be treated.

When working with unknown conditions as those existing at great depths below the earth's surface, we must make certain assumptions. It will be assumed that the pressure affecting the components of the rock will increase one pound per square inch per foot of depth below the surface and the temperature will increase at the rate of 1.5° F. per 100 feet of depth below the surface which has an average temperature of 74° F.

Fundamental Factors

The depth to which oil or gas may occur in rocks is governed by three factors:

1. The depth to which pores, fractures, cavities, and other openings may exist in sedimentary rocks.

2. The depth to which favorable sedimentary rocks such as unaltered sandstone, shale, and limestone can be expected.

3. The depth to which oil or gas can be expected to exist if favorable sedimentary rocks are present.

Depth to Which Openings May Exist

It is important to know at what depth in the earth's crust to expect open cavities. The problem involves a complicated interplay of the character of the stress, the nature of the material, and the environmental factors.

Environmental factors of the earth's crust are pressure, temperature, time, and the presence of solutions. Each of these changes the strength and plasticity of rocks and they all seem to be interdependent. For example, a pressure coefficient of strength may be experimentally determined to describe the variation of strength with confining pressure, but this coefficient changes with temperature changes. Such interdependence makes it necessary to perform a large number of experiments to determine the behavior of rocks under geologic conditions. Such a series of experiments has not been carried out.

A number of experiments have been conducted concerning the influence of a single environmental factor on the strength of rocks. Some of these experiments were used to theorize on the depth that cavities will close. These depths are shown in Figure 1.

The strength of the earth's crust depends on the characteristics of the rocks making up the crust and the total effect of the environmental factors within the earth's crust. In 1915, Barrell[1] estimated the percentage variation in strength of the crust with depth as shown by the nature of departures from isostasy. This data is shown in Figure 2.

In 1925, Barrell[2] gave more specific data as to the strength of the earth's crust as shown in Figure 3. This new

THE DECREASING RATE of discovery of relatively shallow fields in recent years has caused men to think about the maximum depth that oil and gas may be expected. This maximum depth is controlled by the depth to which openings may exist in sedimentary rocks, the depth to which favorable sedimentary rocks may occur, and the depth to which oil and gas can be expected to exist if favorable rocks are present. It is believed possible for oil or gas to be found in sandstones and limestones near the bottom of all sedimentary basins in the U. S., except the San Joaquin-Sacramento Basin of California, listed as having a depth of 65,000 to 75,000 feet, if necessary source rocks are below the trap.

information is based on laboratory experiments down to a depth of 45,934 feet and from this depth the results are based on geodetic evidence.

Chief Reservoir Rocks

Sandstones and limestones are the chief oil and gas reservoir rocks. For this reason, it is necessary that we know the depth at which the environmental factors tend to close the existing openings and connected openings in these types of rocks.

In Sandstone

Petroleum reservoir sandstones are made up predominantly of quartz grains of assorted sizes and shapes that were gradually fitted together under water and later compacted by the weight of the superimposed strata. With increasing depth, the pore space between the grains is affected by compaction, compression, cementation, solution, pressure, and temperature.

Compaction and Compressibility: With increasing depth, compaction brings about an increase in density and a decrease in porosity which is accomplished by rearrangement of the grains. This rearrangement or closer spacing of the grains is the result of increased lateral and vertical pressure.

The compressibility of sandstone depends to a considerable extent on its porosity and its silica content. As the silica content increases, the compressibility decreases; therefore, it might be expected that the compressibility of a quartz sandstone is approximately the order of compressibility of its major component mineral.

Compressibility experiments by Adams and Williamson[3] show that quartz has a compressibility, at surface temperature, of 0.5 percent at 29,000 psi. They further indicate that porosity has little influence on compressibility above 29,000 psi.

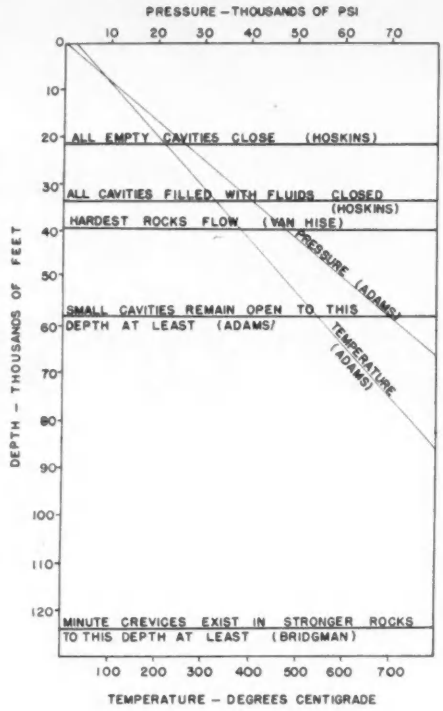


FIGURE 1. Graphic representation of the depth at which openings will close.

In experiments performed on samples of the Woodbine, Frio, and Strawn stands by Carpenter and Spencer,[4] it was found that a reduction in pore volume of 3.608 percent took place when the samples were subjected to a pressure of 8000 psi.

From these data, it is seen that the closing of openings by compression is slight down to the point of the crushing strength of the sandstone.

Crushing Strength: At the point where the crushing strength of a rock is reached most, if not all, of the openings will be closed by the breaking down of the particles and their reorientation. At the crushing point, the density of the rock will be increased very close to the density of the particles making up the sandstone.

Quartz

Quartz is a very strong mineral and has a compressive strength of 324,000 psi at atmospheric temperature and confining pressure.[5] With a confining pressure of 12,000 atmospheres, the compressive strength is increased to 650,000 psi.[6] It is readily seen that the crushing strength of a quartz sandstone will depend largely on the strength of the cementing material.

The crushing strength of the major portion of sandstones ranges from 10,500 to 20,000 psi at surface conditions. As the confining pressure is increased, the crushing strength is increased. One sandstone sample had a strength of 38,000 psi with a confining pressure of 600 atmospheres and 58,000 psi with a confining pressure of 2500 atmospheres.

Cementation: There are two schools of thought concerning the time when cementation most frequently takes place within sediments. One is that the cementing material is laid down with the sediments and the second is that the cementing material is brought in by circulating ground water.

If the cementing material is laid down with the sediments, the process of ce-

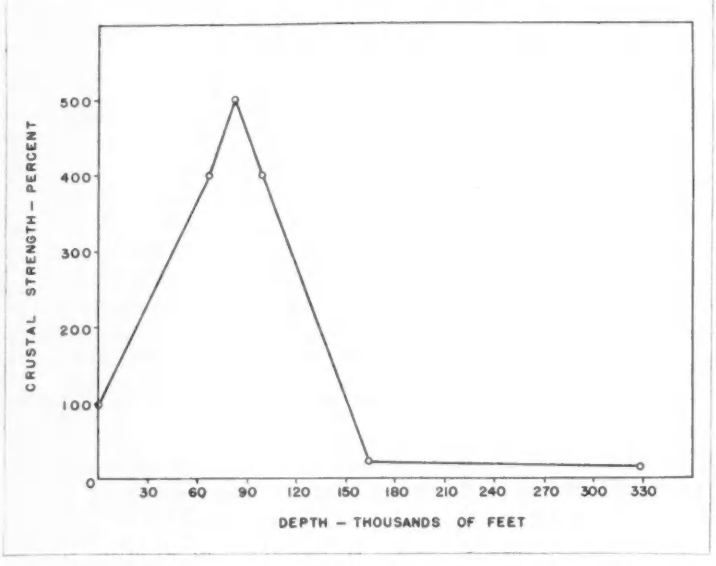


FIGURE 2. The change in strength of the earth's crust with depth.

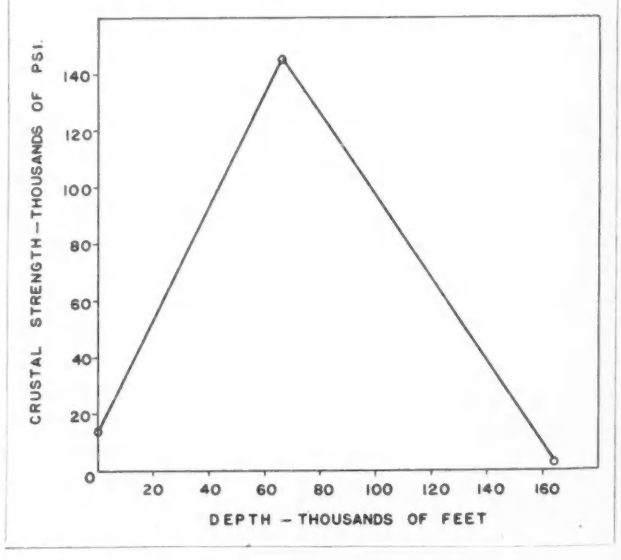
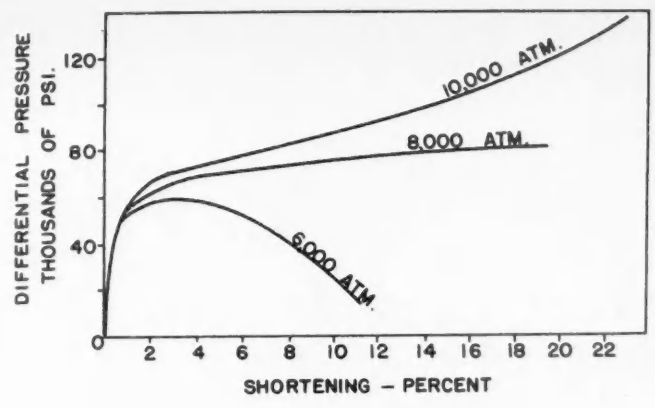


FIGURE 3. The variation in strength of the earth's crust with depth.



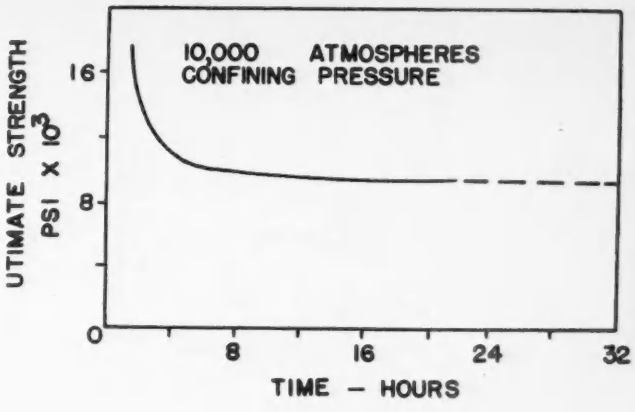


FIGURE 4 (top left). Stress-strain diagram in compression for Solenhofen limestone.

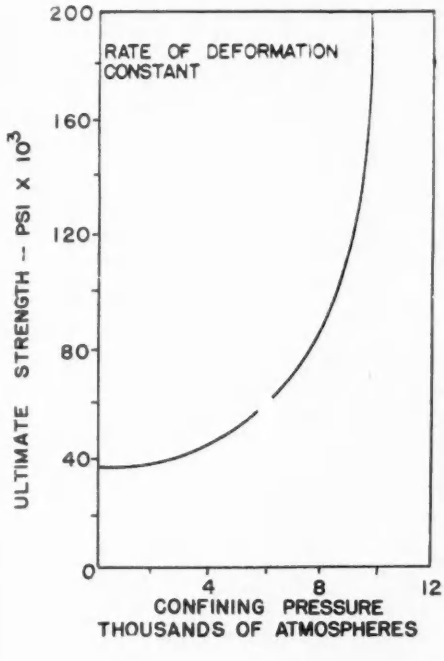


FIGURE 5 (lower left). The strength of Solenhofen limestone as a function of confining pressure.

FIGURE 6 (top right). The strength of Solenhofen limestone as a function of time.

mentation may take place both above and below the water table according to the amount of circulation and solution by the ground water.

Where the material is brought in by the circulating ground water, the process of cementation will largely take place above the ground water table. The amount of silica precipitated, by this method, is believed to be uniform throughout the rock; therefore, the decrease in porosity and permeability is greater for fine-grained sandstone than for coarser-grained sandstones.[7]

In either case, a reduction in pore space and an increase in strength of the sandstone takes place.

Solution: Solution by ground water tends to increase pore space and decrease the strength. Griggs and Bell[8] found that a specimen of quartz had a crushing strength of 348,000 psi at atmospheric conditions. When a similar specimen was subjected to a crushing test at 400° C. and in the presence of a 10 percent Na_2CO_3 solution, the strength was lowered to 58,000 psi.

The extent to which a reaction proceeds between minerals and solutions present in the rocks depends upon the relative solubilities of the minerals under the particular conditions. The influence of high uniform pressure on solubility is usually insignificant; that of temperature, on the other hand, is commonly large and very different for different substances.

Pressures and Temperature: Under geological conditions, high uniform pressure is always accompanied by fairly high temperature. An increase in confining pressure tends to increase the strength of the rock; whereas, an increase in temperature tends to decrease the strength.

Melting: Most rock forming minerals do not melt at sharply defined temperatures. Each mineral begins to melt at a certain temperature, but does not become completely liquid until a considerably higher temperature is reached.

The fusing point of quartz is 1710° C. at atmospheric pressure, a temperature that would exist at a depth of 202,000 feet. When the final melting point is reached, all voids will be closed.

Expansion: Dane[9] found that there are unlike expansions of adjacent grains in rocks because of differences in composition and orientation of the grains. As a result, when a rock is heated, the grains with the largest thermal dilation tend to determine the apparent change of length of the whole specimen, creating internal fractures and pores. In the earth, several factors tend to minimize these effects. The direction of maximum compressibility usually lies close to those of maximum thermal expansion, so that when temperature and pressure tend to vary in the same direction at the same time, the effects partly cancel each other.

When alpha quartz changes to beta quartz between 570 to 580° C., the volume of the beta quartz is 4.55 percent greater than that of alpha quartz at atmospheric conditions.

Conclusions: The average strength of sandstone is close to the surface strength of the crust as given in Figure 3. In this case, the maximum depth at which the sandstone fails in such a way that all cavities will be closed is about 145,000 feet.

If Figure 2 is assumed to be more applicable, it is found that cavities will close in average strength sandstones at a depth of about 65,620 feet.

From the above data, it is seen that there is a wide variation in the two depths at which cavities will close. A depth of 65,620 feet will be used as the minimum depth at which all cavities will be closed due to the failure of the material making up the sandstone.

In Limestone

Limestone is a sedimentary rock com-

Map of deep sedimentary sections.

posed principally of calcium carbonate. The openings in limestone, consequently are extremely irregular in shape, size, and distribution. Porosity may result from fracturing of the rock. Solution tends to increase the openings within limestone, whereas, compression, compaction, and higher temperatures tend to decrease their volume.

Effect of Compression

Compressibility: Tests of compressibility on limestone samples will not give direct information about the reduction of openings caused by fracturing or large solution channels. Compressibilities of various limestones range from 1.41 percent reduction in volume at 8540 psi for carbonaceous limestones[10] to 0.86 percent reduction in volume at 75,000 psi and 476° C. for Solenhofen Limestone.[10] Therefore, it is seen that the effect of compression on closing existing openings in the limestone is slight down to the point of decomposition or after the crushing strength is exceeded.

Decomposition: Adams[32] found that a temperature of 842° F. and a pressure of 96,000 psi is the greatest that Solenhofen Limestone can endure without decomposition when the sample is confined on all sides. The temperature of 842° F. corresponds to a depth of 51,300 feet while 96,000 psi represents the pressure at 96,000 feet.

Crushing Strength and Confining Pressure: As the confining pressure increases, the crushing strength of limestone increases. The majority of types of limestone have crushing strengths that range from 9000 to 20,000 psi while the very strong Solenhofen Limestone has a crushing strength of 32,980 psi.

The stress-strain diagram in compression and the effect of confining pressure and time on the ultimate strength of Solenhofen Limestone is shown in Figures 4, 5, and 6.

Solutions: Solutions may either increase or decrease porosity in limestone, but the tendency to increase porosity is predominant. Solution along with temperature tends to decrease the strength of limestones.

Conclusions: Temperature is the important factor in determining the depth at which limestone will decompose and all cavities will close. The depth at which this decomposition will take place is around 51,300.

Fundamentally, the uneven contact between igneous rocks and sedimentary rocks is the limiting factor of depth and this surface is as irregular as the surface of the earth. The important geologic section in the case of deep oil prospects is the greatest thickness of sedimentary strata in unbroken vertical succession at a single locality.

The estimated maximum thickness of certain sedimentary sections in the U. S., more than 20,000 feet deep is shown in the map.

Depth to Expect Oil or Gas

At first it appears that any liquid substance at a great depth should boil and become dissipated as vapor and gas because of the heat existing in the earth's crust. However, an increase of pressure raises the boiling point of liquids thus making the depth greater at which liquids will vaporize.

Adams[32] holds that liquids can exist as far down as cavities occur in the rocks, therefore, it would be possible for oil or gas to occur as deep as pore spaces exist if sedimentary conditions are favorable.

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oil field that in general, among crude oils of the same age, the API gravity and the content of the lighter constituents tend to increase, and the contents of sulfur and carbon tend to decrease, with the depth of the producing sands. It has also been pointed out that the base of the Gulf Coast crudes becomes less naphthenic and more paraffinic with increasing age and depth.[12]

Conclusions

In drawing conclusions from the above presented data, it must be remembered that there is no way to quantitatively calculate or predict the effects of compression, cementation, solution, pressure, and temperature on each other and on the properties of the rock. We know that with greater confining pressure the ultimate strength of a substance tends to increase and that with a higher temperature the strength of rocks tends to decrease.

There is no way to predict the influence of time other than to say that a lower uniform temperature and pressure can be more effective over a great length of time than higher temperature and pressure of short duration. Nevertheless, the following conclusion appears justified.

Theoretically, oil or gas may occur in sandstones down to a depth of 65,620 feet and in limestones to 51,300 feet. This would make it possible for oil or gas to be found near the bottom of all favorable sedimentary sections in the U. S., except the San Joaquin-Sacramento basin in California listed as having a depth of 65,000-75,000 feet, if the necessary source rocks are present below the trap.

About the Author

JAMES S. CLONINGER was born in Marshall, Texas, and was graduated from Texas A. & M. College with a B.S. degree in geological and petroleum engineering. He is now associated with The Pure Oil Company as a geologist in the Houston office.

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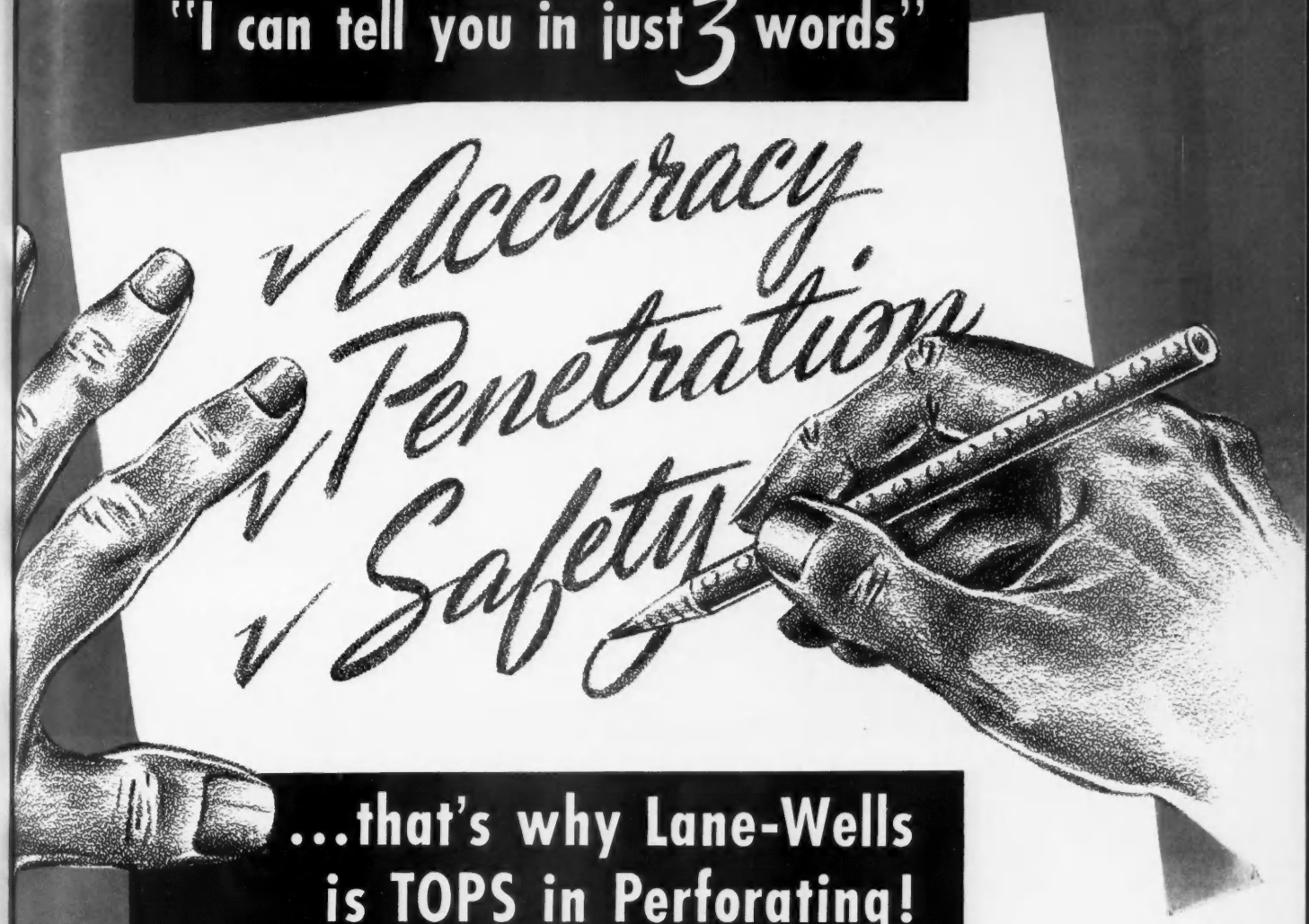

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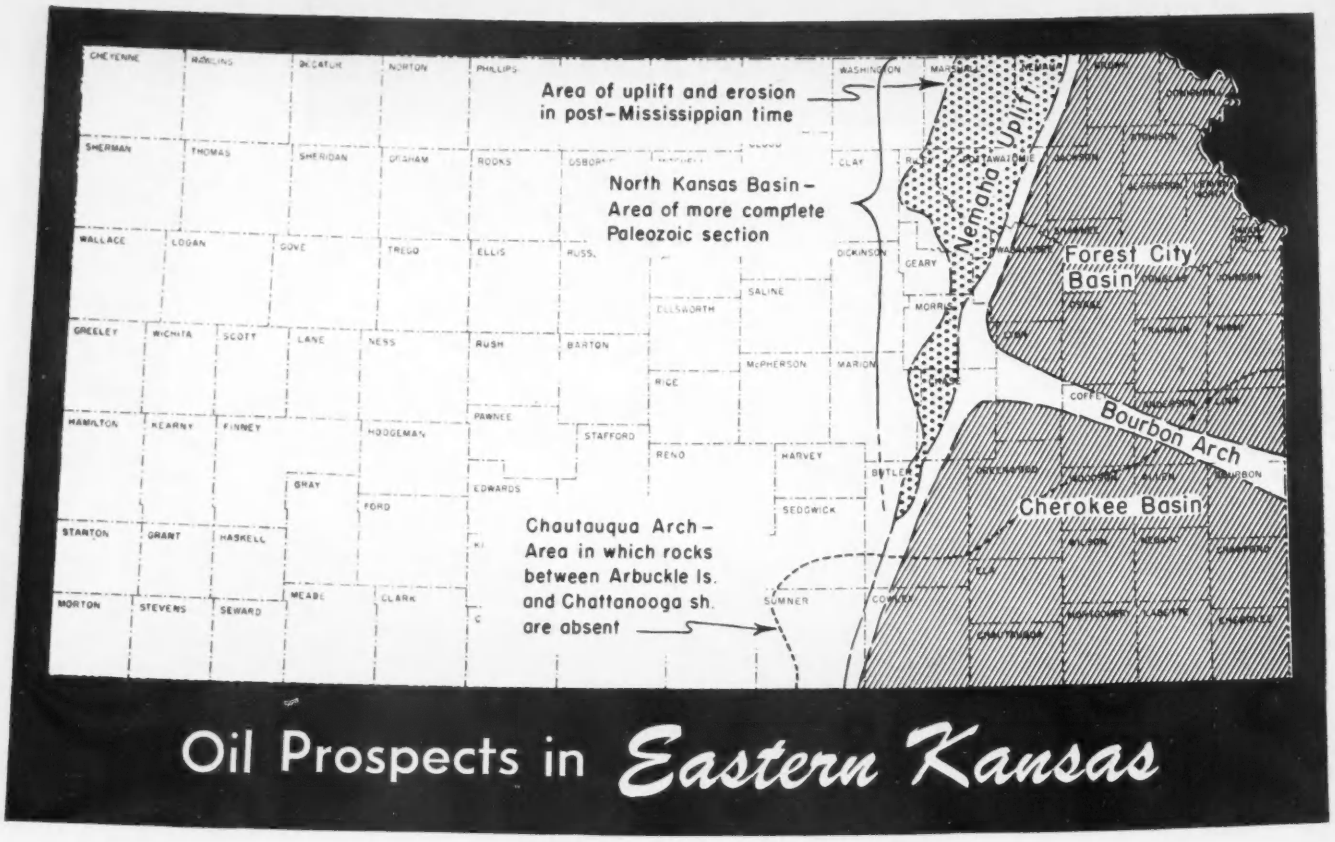

Area of uplift and erosion in post-Mississippian time
North Kansas Basin – Area of more complete Paleozoic section
Nemaha Uplift
Forest City Basin
Bourbon Arch
Cherokee Basin
Chautauqua Arch – Area in which rocks between Arbuckle ls. and Chattanooga sh. are absent
Oil Prospects in Eastern Kansas

FIGURE 1. Sketch map of Eastern Kansas showing large tectonic elements mentioned in the text. The North Kansas basin and Chautauqua arch are geologically older than the other basins and uplifts.

By DR. JOHN MARK JEWETT
University of Kansas, Lawrence, Kansas

COMMONLY referred to as "eastern shallow" or "shallow stripper," eastern Kansas sparked the interest of oil operators in the spring of 1949 when The Carter Oil Company completed an exceptionally good producer in the Viola limestone at 3199 feet on the Davis Ranch in Waubaunsee County. The well started a brisk play reminiscent of the 1920's, and has caused a re-evaluation of the prospects of that section of the state.

Carter completed Davis 1, SW SE SW 33-13s-10e, for initial daily production of 2580 barrels. Since then, eight additional wells have been completed on the Davis Ranch, with potentials ranging up to 3000 barrels per day. During 1949, approximately 50,000 barrels of oil were marketed from the new pool.

In Waubaunsee and neighboring counties, 37 dry wildcats have been drilled since the Davis Ranch discovery but, despite this string of failures, it is believed that other important pools will be opened in the general area. Detailed surface mapping, core drilling and geophysical investigations in progress promise to reveal favorable structures, and it is expected that the western portion of the Kansas sector of the Forest City Basin will attract considerable activity in the near future.

It is significant that the prolific Davis Ranch pool is in Ordovician rocks occurring in a broad synclinal belt east of the Nemaha Uplift. This is a broad structural trough many miles in width located in the deepest part of the Forest City Basin. Previously, no doubt because of its synclinal nature, this area attracted little attention, and following several failures on the higher parts of the Nemaha Ridge, production in the Forest City Basin mainly had been sought farther east. However, "Hunton" production in the trough in Brown and Nemaha counties, Kansas, and in the Falls City (Nebraska) field had been established before the Wabaunsee County discovery.

DEVELOPMENT DURING the past year of the Davis Ranch pool in Waubaunsee County has stimulated search for other similar new and deeper pools in this general area of eastern Kansas, which heretofore has been primarily a district of shallow, stripper production. In Davis Ranch pool, producing from Viola limestone at about 3200 feet, nine oil wells have been completed, with potentials ranging up to 3000 barrels per day.

Because of this renewed activity in eastern Kansas it is regarded as timely to call attention to eastern Kansas as a whole. Attractions range from the proved reserves of oil, chiefly in Pennsylvanian rocks, that can be produced by secondary recovery methods, to the possibilities of new discoveries in Pennsylvanian and older rocks. Considerable oil has already been produced from pre-Pennsylvanian rocks in eastern Kansas.

In this article the 43 counties that lie wholly east of the 6th Principal Meridian, the line of separation of east and west land ranges in the state, are regarded as comprising "eastern Kansas." This is an arbitrary but convenient separation. Oil in commercial quantities has been found in 35 of these counties, and 32 of them have current production totaling almost 20 million barrels annually.

Geology of Eastern Kansas

Many publications that discuss the geology of eastern Kansas are available. A condensed resume is presented here. For details of the geology and statistics of production and developments, refer-

ence is made to publications of the State Geological Survey and other papers listed at the end of this article.

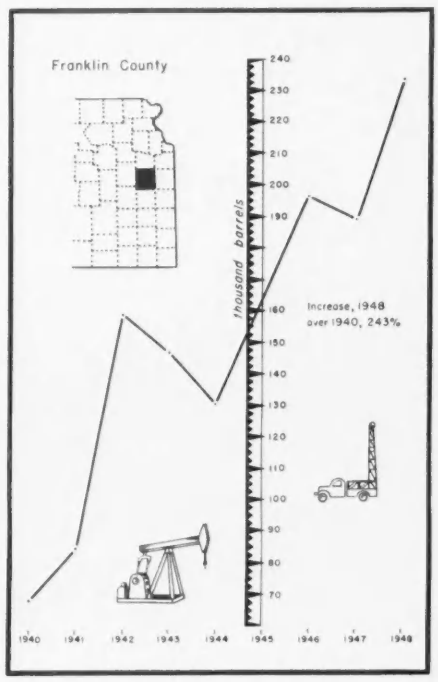
Oil-bearing rocks: The sedimentary cover above crystalline rocks everywhere in eastern Kansas is comparatively thin, ranging from little more than 500 feet in the northern part of the Nemaha Anticline to about 4800 feet in Cowley County. Rocks of all the Paleozoic systems are present, but the geologic section in the various parts is far from uniform, because the sedimentary and structural history is extremely complex. Sedimentary beds ranging in age from Late Cambrian to Middle or Late Pennsylvanian are in contact with the Pre-Cambrian floor. Oil is produced from sandstones, limestones, and dolomites ranging in age from Ordovician to Permian.

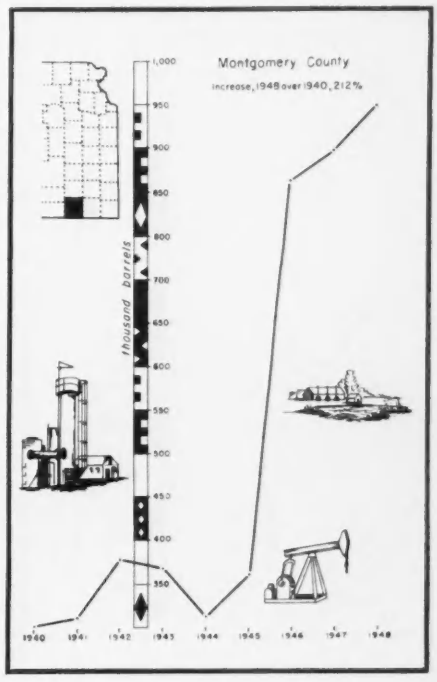
A brief discussion of eastern Kansas geology can best be attained by referring to the several major structural provinces.

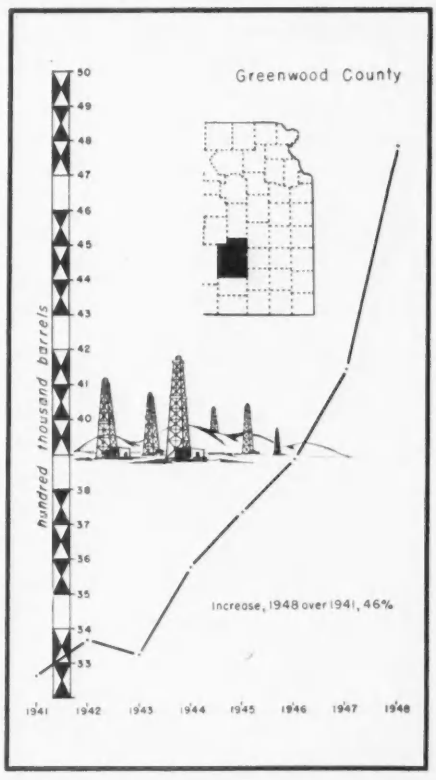
The Chautauqua Arch: In southeastern Kansas there is a broad area in which early Ordovician rocks (Arbuckle), flanked on the north and west by younger Ordovician beds, lie next below the widespread pre-Chattanooga disconformity. This is the Chautauqua Arch (Figure 1), the westward extension of the ancestral Ozark Uplift. Before burial under Late Devonian or Early Mississippian sediments, the region was nearly leveled by deep erosion, and as a result, Chattanooga shale and Mississippian limestones lie on weathered Arbuckle rocks in the main part of the area and overstep younger formations on its flanks. As far eastward as Montgomery and Labette counties there are oil pools in the upper part of the Arbuckle assemblage where oil occurs in local "highs" formed partly after the Ordovician rocks were buried. Porosity there is largely due to pre-burial weathering and partly perhaps to dolomitization. A significant number of the known Arbuckle and higher Ordovician pools lie below higher oil pools. Some Simpson and Viola pools in the western part of the Chautauqua Arch are to be regarded as in stratigraphic traps on the flanks of the uplift or on the flanks of the geologically younger Nemaha Uplift.

The North Kansas Basin: The North Kansas Basin (Figure 1) is a pre-Chattanooga structure that lies north of the Chautauqua Arch and east of the ancestral Central Kansas Uplift—the Ellis Arch (Jewett, 1949, Figure 11; Moore and Jewett, 1942, Figure 7). Northward from the Chautauqua Arch, the Chattanooga shale and Mississippian limestones overstep successively Ordovician rocks including the St. Peter (Simpson) sandstone, the Viola dolomite, the Maquoketa (Sylvan) shale, and Silurian and Devonian rocks known as the "Hunton." Hence in northeastern Kansas a more complete Paleozoic section is encountered, but it is one of many disconformities and overlaps.

Porosity in the "Hunton" limestone in northeastern Kansas largely is due to pre-Chattanooga weathering. However, the "Hunton" pools in Brown and Nemaha counties, like those in the Viola and Arbuckle elsewhere in eastern Kansas, may in part be regarded as being in stratigraphic traps, inasmuch as the pre-Chattanooga and pre-Maquoketa surfaces are beveled ones; if one could see the ancient weathered terrains, without doubt he would see that weathering was differential in accordance with the lithologies of the rock layers. There are numerous disconformities in Mississippian







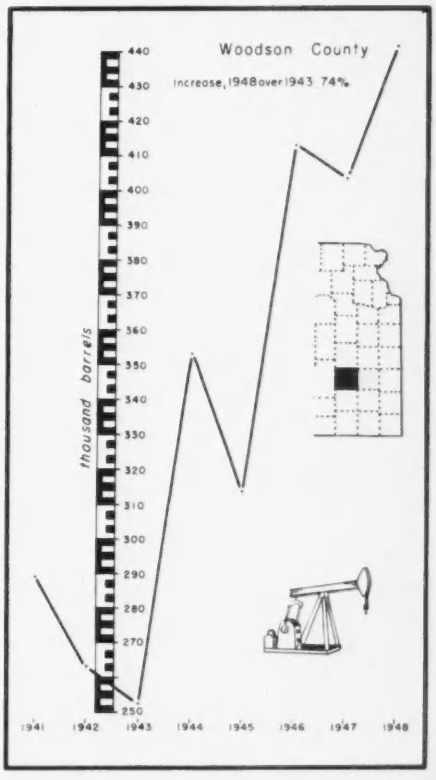


FIGURE 2. (Top Left.) Trend of recent oil production in Franklin County. Increase is due principally to water flooding.
FIGURE 3. (Lower Left.) Trend of recent oil production in Greenwood County.
FIGURE 4. (Top Right.) Trend of recent oil production in Montgomery County.
FIGURE 5. (Lower Right.) Trend of recent oil production in Woodson County. As in other parts of Eastern Kansas the marked increase is due chiefly to water flooding.

and lower rocks (Lee, 1943; Lee, Leatherock, and Botinelly, 1948) other than the ones that may receive some emphasis here, and stratigraphic and other kinds of traps may occur at several horizons. Certainly there are many zones of porosity, and the possibilities of "reefs" are worthy of consideration.

The Nemaha Anticline: An anticline (Figure 1) whose buried crystalline core is referred to often as the "granite ridge" or the "Nemaha Mountains" and which trends south-southwestward across Kansas from Nemaha County to Sumner County commonly is known as the Nemaha Anticline but might more properly be called the Table Rock Anticline (Condra and Bengston, 1915, pp. 25, 39). Mississippian and older rocks are tilted and eroded on the flanks of this uplift, which is much steeper in most places along its length on the east than on the west (Jewett and Abernathy, 1945, pls. 1-3). Pennsylvanian sediments on the anticline overstep and overlap rocks ranging in age from Pre-Cambrian to Mississippian. Pennsylvanian sediments lie on Pre-Cambrian rocks in a belt extending in a northeastward trending direction from a point in T. 11S-10E and in isolated areas farther south. The extreme northern part of the eroded ridge was not covered by Pennsylvanian deposits until about the close of Middle Pennsylvanian time. Older Pennsylvanian beds overstep and overlap Pre-Cambrian and Paleozoic rocks along the southern part of the axis of the ridge. In general, Pre-Cambrian rocks lie about 2000 feet lower a short distance east of the uplift than on its axis.

The geologic history of the Nemaha Anticline has been made known largely by the studies of Wallace Lee.

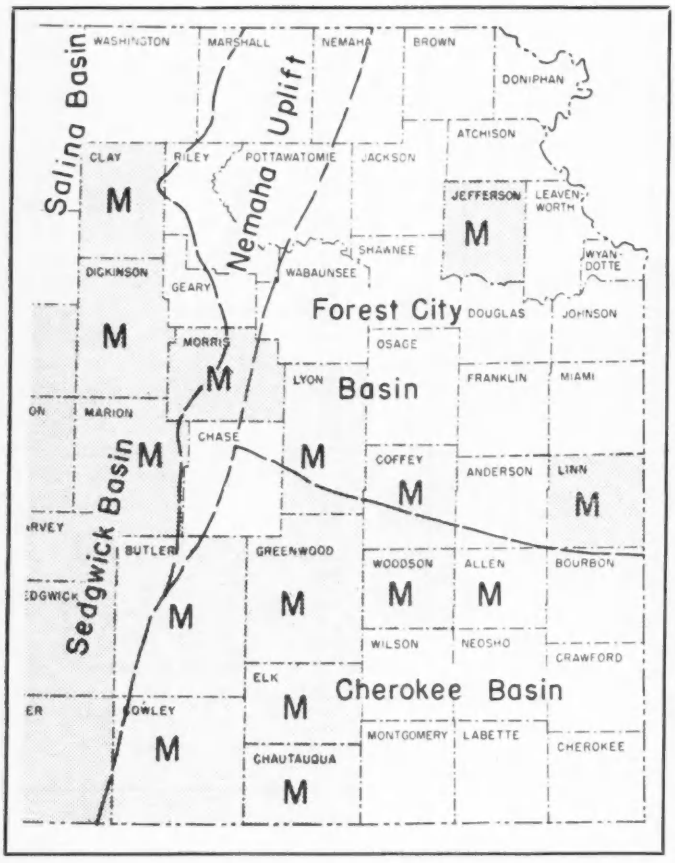
The famous El Dorado and Augusta oil fields lie in and on the flanks of the Nemaha Anticline. At El Dorado and Augusta the chief producing zone is along the beveled pre-Pennsylvanian surface cut in Ordovician rocks (Jewett, 1949, pp. 105-110). Several other fields, mostly on the flanks of the uplift in its southern part, have yielded great quantities of oil from Ordovician, Mississippian, and Pennsylvanian rocks.

In Nemaha County less than 600 feet of Pennsylvanian sediments lie on Pre-Cambrian rocks on the axis of the anticline, but southward the sedimentary cover increases in thickness. Along the axis in Butler County (except on the highest parts of the granite core) a thin section of Arbuckle rocks lies between the crystalline rocks and about 2250 feet of Pennsylvanian and Permian beds. The sedimentary section, of course, is much thicker on the flanks.

The Forest City Basin, Bourbon Arch, and Cherokee Basin: Thinning of Cherokee sediments (basal Pennsylvanian in eastern Kansas, but of middle Pennsylvanian age) along a narrow belt extending from Bourbon County to Lyon County afford a line of separation between the Forest City Basin on the north and the Cherokee Basin on the south (Figure 1). This area is known as the Bourbon Arch (Lee, 1943, Figure 3; Jewett, 1949, Figure 9, pp. 58-59). The Nemaha Anticline marks the west boundaries of the two basins.

Pennsylvanian sedimentation seemingly began earlier in the Forest City Basin than in the Kansas part of the Cherokee Basin, but it is to be noted that the two "basins" are parts of a large area of sedimentation that has great lateral extent and that Pennsylvanian rocks older than any known in eastern Kansas occur in northeastern Oklahoma and probably in southern Iowa.

The area of the Bourbon Arch roughly is a belt of lithologic changes in several Pennsylvanian rock divisions, and apparently at several times in Middle and Late Pennsylvanian time, sediments from the northeast and from the south met and overlapped. Hence the nature of shoestring sandstones and other rocks differs



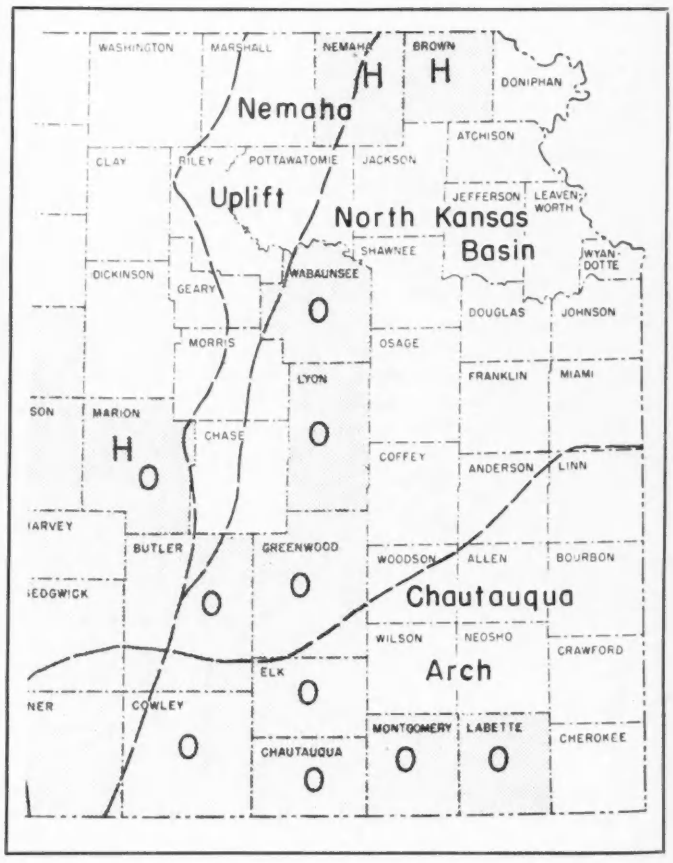


FIGURE 6 (left). Map of Eastern Kansas showing (M) counties in which oil has been found in Mississippian limestone and "chat" reservoirs. Figure 7 (right). Map of Eastern Kansas showing counties in which oil has been found in "Hunton" limestone and Ordovician rocks. Structural provinces are not of the same age (See Figure 1) but are shown because of their significance to oil in pre-Mississippian rocks. H, "Hunton"; O, Ordovician.

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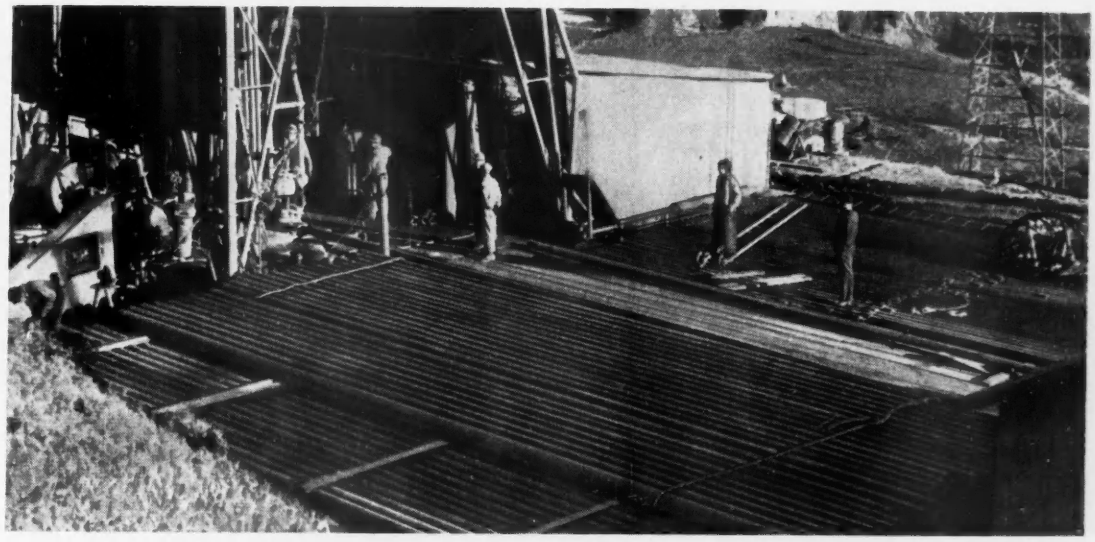

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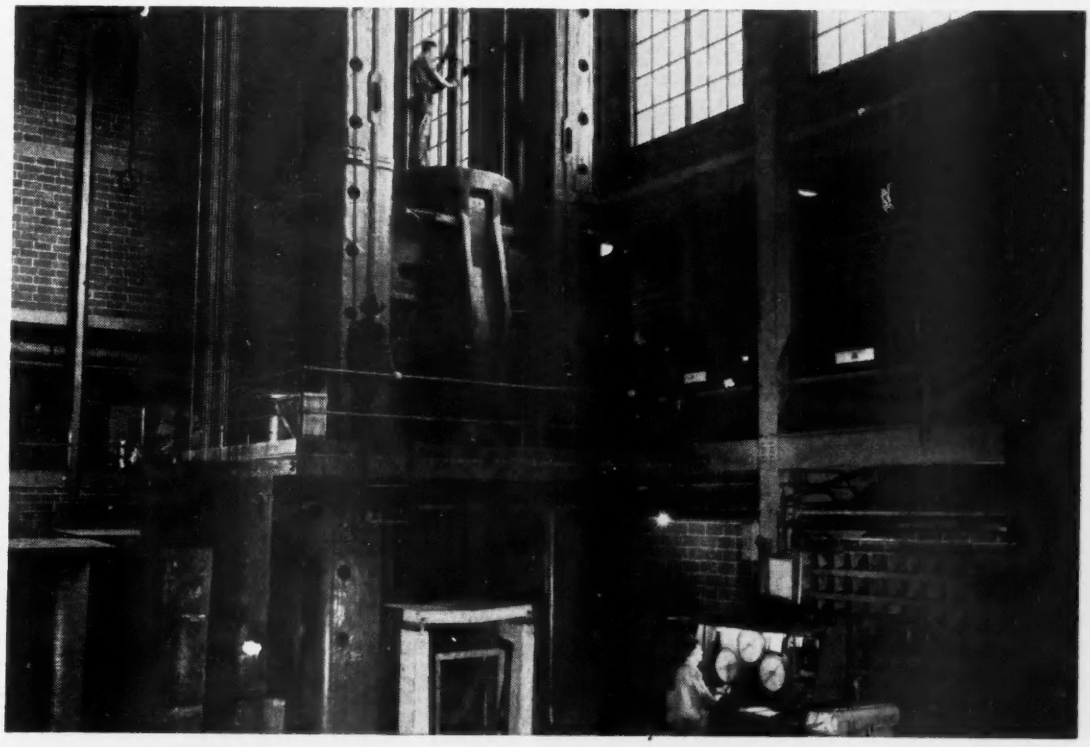

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in the two basins, a condition that well may be taken into consideration in reference to petroleum in Pennsylvanian rocks in eastern Kansas.

In the Forest City Basin a maximum of slightly less than 5000 feet of sedimentary beds lies above crystalline Pre-Cambrian rocks. This thickness, however, is encountered only in the western part of the basin. A more nearly average thickness is 2500 feet. On the Bourbon Arch near the Kansas-Missouri line Pre-Cambrian rocks are reached at about 1500 feet. In the southeast corner of the state about 1500 feet of Mississippian, Ordovician, and Cambrian beds lie above the crystalline floor, but in the deepest part of the Cherokee Basin, in Cowley or Sumner County, 5500 or more feet of sediments (Permian, Pennsylvanian, Mississippian, Ordovician, and Cambrian) cover the basement rocks.

The general dip of surface formations in eastern Kansas is westward and northwestward away from the Ozarks. Twenty feet per mile is perhaps the average inclination. This westward tilting took place largely in pre-Cretaceous time, but the westward dip that accounts for the name Prairie Plains Monocline was increased as late as post-Lower Cretaceous time and perhaps later.

In no way should these brief remarks about the geology of eastern Kansas be interpreted as meaning that the stratigraphy and structure are simple. On the contrary, the geological developments have been exceedingly complex, and must be taken into consideration by students of oil accumulation here.

Currently, eastern Kansas is yielding nearly 20 million barrels of oil per year. About 65 percent comes from the Cherokee Basin, 28 percent from the Nemaha Uplift fields, and 7 percent from the Forest City Basin. Production chiefly is from Pennsylvanian sandstones, but Mississippian, "Hunton," and Ordovician rocks yield consequential amounts.

Oil in Pennsylvanian Rocks

Pennsylvanian sandstones, ranging in depth from about 100 to about 3000 feet, are the chief known reservoir rocks in eastern Kansas. The shallower sands occur in the eastern part, where there is no Permian cover on Pennsylvanian beds and where the Pennsylvanian section itself has been reduced in thickness by erosion. In general, these sandstone bodies may be separated into two classes —"sheetlike sands" and "shoestrings." The distinction is obvious. However, the sand bodies all are more or less lenticular and are of several geologic types. Shoestring sands are believed to be in part channel fillings and in part ancient marine bars. Other sand bodies may be regarded as parts of deltaic sediments. Thickness of productive sandstones ranges from a few feet to 100 or more. Shale breaks are more or less common. Sandstones in the Kansas City and Lansing groups are considerably different from those both older and younger.

The finding of shoestring reservoirs has been largely a matter of hit and miss drilling or the following of "trends." Seemingly, structural conditions played little part in the role of accumulation. However, a combination of porosity changes and anticlinal conditions is responsible for oil and gas accumulations in the rocks. Locally, oil and gas have accumulated in curved portions of shoestring sands that lie in a relatively high position due to regional dip (Rich, 1926, p. 579). Accumulation in the broader sheetlike sands largely is controlled by structural conditions.

Importance of Water Flooding

Although it can be anticipated that new Pennsylvanian fields will continue to be opened, eastern Kansas has a proved future because of secondary recovery.

Secondary recovery of oil by water flooding in partly depleted fields in eastern Kansas has been practiced widely for several years (Grandone, 1944; Abernathy and Jewett, 1946; Jewett, 1948, 1949, pp. 24-27; Sweeney, 1948, 1949, 1949a; Ver Wiebe, Jewett, and Nixon, 1949, pp. 23-26). About half of the current production is obtained by flooding Pennsylvanian sandstone (and locally Mississippian "chat") reservoirs.

It is believed that the amount of oil in eastern Kansas that can be recovered by water-flooding methods is in the magnitude of ¼ billion barrels. This is judged to be a conservative figure, and is in accordance with the judgment of Sweeney, who estimated that at the beginning of 1948, water-flood reserves in eastern Kansas totaled 251,493,000 barrels.

The recent trends in production in four counties in which water flooding is the more important method of recovery are shown in Figures 2, 3, 4, and 5.

Mississippian Production in 15 Counties

Mississippian limestone and "chat" oil pools have been found in eastern Kansas since 1916 or earlier. As shown in Figure 6, oil has been produced from these rocks in 15 eastern counties (and in at least 98 fields). Among the 15 counties, only Clay, Coffey, Linn, and Lyon do not now have fields producing from Mississippian rocks. During 1949 seven Mississippian pools were discovered in Butler County and one in Morris County.

Exact segregation of oil produced from Mississippian reservoirs has not been made, inasmuch as production in several fields comes from both Mississippian and other rocks. However, it is estimated that the total current production from Mississippian limestones and "chat" in 11 counties is well above 2 million barrels each year or about 10 percent of the total yield of all the eastern counties.

Deposits of chert and clay ranging in thickness up to several feet and occurring on more compact limestone commonly are called "Mississippian chat." Other fields produce from zones near the top or well down in the Mississippian section, which principally comprises limestone formations.

Mississippian limestones are exposed in a small area in the southeast corner of Kansas. Elsewhere in eastern Kansas the thickness of overlying rocks ranges from a few feet (immediately west of the Mississippian outcrops) to about 3400 feet. Various Mississippian limestone formations ranging in age from Osagian or Kinderhookian through Meramecian are present throughout most of eastern Kansas (Lee, 1939, 1940, 1943, pp. 66-79). These rocks were removed by late Mississippian or early Pennsylvanian erosion from a large area along the northern part of the Nemaha Anticline, northward from the northern part of Chase County, and from the higher parts of the uplift as far south as Augusta, Butler County. Thicknesses of the Mississippian limestone section range from a featheredge to more than 450 feet. Various kinds of limestone and dolomite are present, and chert is characteristic of some of the formations. The distribution of the several Mississippian formations in Kansas is shown by Lee (1940, pl. 8).

In large areas drilling has not reached or has only touched the top of the Mississippian limestone. Areas in which gas has been found in overlying Pennsylvanian rocks are believed to be especially

About the Author

DR. JOHN MARK JEWETT, a native Kansan, has spent much of the last two decades investigating Kansas geology. Geology of coal, oil and gas in eastern Kansas ground-water resources and the application of stratigraphy to engineering projects and mineral developments have come within the scope of his activities.

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favorable for Mississippian reservoirs. Most dry wells that have penetrated the total Mississippian section are outside areas of Pennsylvanian oil or gas production. Several known Mississippian pools are in fields in which oil is produced also from Pennsylvanian rocks.

Possibilities of Reefs in the Hunton Limestone

For convenience, the term Hunton limestone is used for formations that lie below the Chattanooga shale and above rocks of Ordovician age. These are Silurian and Devonian rocks, and according to Lee (1943, pp. 43-53, Figure 3), sediments of the two systems in eastern Kansas are separated by an angular unconformity. Devonian and Silurian rocks occur in northeastern Kansas, east and west of the Nemaha anticline, and in a small area in southeastern Marion County. The greatest known thickness of Devonian beds in eastern Kansas is about 250 feet and of Silurian about 150 feet (Lee, 1943, pp. 45, 47). These rocks are chiefly limestone and dolomite. That they may contain porous reefs is an interesting possibility.

The upper part of the Hunton limestone, where porosity probably is due to weathering that took place before burial under Chattanooga beds, yields oil in Brown, Marion, and Nemaha counties (Figure 7), and near Falls City, Neb. The Wenger pool in Marion County is on the west flank of the Nemaha Uplift, and the other pools are in the deep part of the Forest City Basin not far east of the anticline, structurally in a position similar to that of the Davis Ranch Viola pool in Waubaunsee County.

47 Known Pools in Ordovician Rocks

As shown in Figure 7, oil has been found in Ordovician rocks in ten eastern Kansas counties and in 47 pools. In a large number of the fields, oil is found also in higher rocks, and it is noteworthy that in many areas of prolific Pennsylvanian production, Ordovician rocks are very inadequately tested.

Maquoketa shale, Viola limestone (including Kimmswick limestone, Decorah shale, and Plattin limestone), St. Peter sandstone ("Wilcox," Simpson), Cotter and Jefferson City dolomites, Roubidoux formation, Gasconade and Van Buren dolomites, and the Gunter sandstone comprise the Ordovician rocks known in eastern Kansas. They are underlain by the Eminence and Bonneterre dolomites and the Lamotte sandstone of Upper Cambrian age. Rocks between the St. Peter and Lamotte sandstones commonly are called Arbuckle, but the Bonneterre does not properly belong in the Arbuckle assemblage.

The complexity of stratigraphy of these deeply buried rocks allows only elementary statements in a paper of this sort. As stated earlier, in the Chautauqua Arch area, Mississippian limestone or Chattanooga shale lies on the eroded surface of Arbuckle rocks. Hence the St. Peter sandstone and younger Ordovician rocks are absent there, as well as along the northern part of the Nemaha Uplift. For thickness and distribution of various units of these rocks, reference is made to publications by Lee (1943), Jewett (1949, pp. 48-53), Keroher and Kirby (1948), Leatherock (1945), and McClelland (1930).

Although surface mapping and shallow core drilling still are useful methods, it seems probable that because of their complexity, the deeper rocks in eastern Kansas can be appraised properly only through much geophysical exploration.

Most of the oil that has been found in Ordovician rocks in eastern Kansas occurs not far below disconformities next below (1) Pennsylvanian sediments, (2) Chattanooga shale or Mississippian limestone, and (3) next below the Maquoketa shale, and in the St. Peter (Simpson) sandstone. Geologic conditions in the vicinities of known oil occurrence in these deeper rocks may well be reexamined, and as many geologic data as are possible should be had before test locations are made. For example, the Bradfield pool, Lyon County, (Jewett, 1949, pp. 220-221) should be of interest relative to the possibilities of other Viola pools.

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Exploration

Leads 1949 Period

By CECIL W. SMITH, Statistical Editor

THE high rate at which exploratory drilling was conducted during the first two months of 1950 was continued through March, giving the year's completed wells a 12.9 percent lead over last year's record-breaking number.

So far this year, total drilling has enjoyed an increase over last year's rate, but the over-all gain was not as great as in the exploratory phase. In other words, field development drilling activity has not been so intense. For the first quarter, all well completions totaled only about 8 percent more than those of last year's comparable period, while exploration accounted for about 13 percent more wells.

Exploration in March resulted in 620 wells being finaled compared with 541 completed in February, which was a

Summary of Results of Exploratory Drilling

ITEM	Mar., 1950	Feb., 1950	Three Months: Jan.-Mar. 1950	1949	Percent Diff.
Oil Discoveries	89	57	227	216	+ 5.1
New Fields	59	38	156	155	+ 0.6
New Pays	30	19	71	61	+ 16.4
Distillate Discoveries	7	4	21	33	— 36.4
New Fields	5	3	18	17	+ 5.9
New Pays	2	1	3	16	— 81.3
Gas Discoveries	12	10	38	31	+ 22.6
New Fields	11	9	34	26	+ 30.8
New Pays	1	1	4	5	— 20.0
Total Discoveries	108	71	286	280	+ 2.1
Extensions to Fields	30	23	74	60	+ 23.3
Oil Fields	25	20	64	56	+ 14.3
Distillate Fields	1	1	3	3	.....
Gas Fields	4	2	7	1	+600.0
Total Prod. Tests	138	94	360	340	+ 5.9
Dry Holes	482	447	1437	1252	+ 14.8
Wildcats	469	429	1364	1234	+ 10.5
New Pays	.....	.....	4	2	+100.0
Outposts	13	18	69	16	+331.3
Total Expl'tory Tests	620	541	1797	1592	+ 12.9
Percent Productive	22.3	17.4	20.0	21.4	.....
Percent Dry	77.7	82.6	80.0	78.6	.....

Results of Exploratory Drilling in March and First 3 Months, 1950-1949, by Districts

State or District	MONTH OF MARCH, 1950													FIRST THREE MONTHS, 1950																	
	Productive Tests									Total Productive	Unproductive Tests			Total Exploratory Tests	Productive Tests								Unproductive Tests				Total Exploratory Tests			
	New Fields			New Pays			Extensions				Wildcats	New Pays	Outposts		New Fields			New Pays			Extensions			Total Productive		Wildcats	New Pays	Outposts	Total Dry			
	Oil	Dis.	Gas	Oil	Dis.	Gas	Oil	Dis.	Gas						Oil	Dis.	Gas	Oil	Dis.	Gas	Oil	Dis.	Gas	3 Mo. 1950	3 Mo. 1949				3 Mo. 1950	3 Mo. 1949	3 Mo. 1950	3 Mo. 1949
Alabama	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2	.....	.....	2	.....	.....	1	.....	.....	.....	.....	.....	.....	1	.....	5	.....	.....	5	2	6	2
Arizona	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3	.....	3
Arkansas	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	5	.....	.....	5	1	1	.....	.....	.....	.....	.....	.....	.....	2	2	17	.....	2	19	10	21	12
California	3	.....	.....	.....	.....	.....	3	.....	1	7	25	.....	.....	32	6	.....	1	1	.....	.....	3	.....	1	12	14	76	1	5	82	46	94	60
Colorado	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	4	.....	1	5	6	5	6
Florida	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	4	.....	.....	4	6	4	6
Georgia	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3	.....	.....	3	2	3	2
Idaho	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	1	.....	1	.....
Illinois	2	.....	.....	2	.....	.....	5	.....	.....	9	42	.....	.....	51	6	.....	.....	4	.....	.....	15	.....	.....	25	17	131	.....	.....	131	93	156	110
Indiana	3	.....	.....	.....	.....	.....	.....	.....	.....	3	30	.....	.....	33	8	.....	.....	.....	.....	.....	1	.....	.....	9	13	83	.....	.....	83	105	92	118
Iowa	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Kansas	6	.....	1	.....	.....	.....	.....	.....	.....	7	23	.....	.....	30	21	.....	1	.....	.....	.....	.....	.....	.....	22	18	92	.....	.....	92	83	114	101
Kentucky	.....	.....	1	.....	.....	.....	.....	.....	.....	1	3	.....	.....	4	1	.....	1	.....	.....	.....	.....	.....	.....	2	1	8	.....	.....	8	7	10	8
Louisiana	3	1	.....	1	2	1	1	.....	.....	9	13	.....	.....	22	7	4	2	4	2	1	4	.....	1	25	31	43	1	.....	44	42	69	73
North Louisiana	.....	.....	.....	.....	2	1	.....	.....	.....	3	5	.....	.....	8	1	.....	.....	.....	2	1	1	.....	1	6	9	20	1	.....	21	20	27	29
South Louisiana	3	1	.....	1	.....	.....	1	.....	.....	6	8	.....	.....	14	6	4	2	4	.....	.....	3	.....	.....	19	22	23	.....	.....	23	22	42	44
Maryland	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	1	.....	1	.....
Michigan	1	.....	.....	.....	.....	.....	.....	.....	.....	1	22	.....	.....	23	7	.....	1	1	.....	.....	.....	.....	.....	9	10	67	.....	.....	67	83	76	93
Mississippi	1	.....	.....	.....	.....	.....	.....	1	.....	2	15	.....	1	18	3	1	.....	1	.....	.....	.....	1	.....	6	2	35	.....	2	37	23	43	25
Missouri	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2	.....	.....	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2	.....	.....	2	.....	2	.....
Montana	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3	.....	.....	3	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	9	.....	.....	9	6	9	6
Nebraska	.....	.....	.....	.....	.....	.....	.....	.....	1	1	2	.....	.....	3	.....	.....	1	.....	.....	.....	.....	.....	1	2	.....	9	.....	.....	9	.....	11	.....
Nevada	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
New Mexico	1	.....	.....	.....	.....	.....	1	.....	.....	2	3	.....	.....	5	5	.....	.....	3	.....	.....	3	.....	.....	11	3	13	.....	2	15	10	26	13
New York	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
North Dakota	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Ohio	.....	.....	.....	.....	.....	.....	.....	.....	1	1	3	.....	.....	4	.....	.....	.....	.....	.....	.....	1	.....	1	2	2	4	.....	.....	4	13	6	15
Oklahoma	7	.....	1	1	.....	.....	.....	.....	.....	9	33	.....	.....	42	17	.....	2	7	.....	.....	4	1	1	32	22	106	.....	.....	106	101	138	123
Oregon	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Pennsylvania	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	1
South Dakota	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2	.....	.....	2	.....	2	.....
Tennessee	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	3	.....	.....	3	5	3	6
Texas	32	4	8	25	.....	.....	15	.....	1	85	230	.....	12	327	73	12	24	48	1	3	33	1	2	197	191	622	1	55	678	572	875	763
Dist. 1 S. Central	1	.....	1	.....	.....	.....	.....	.....	.....	2	22	.....	.....	24	3	.....	1	.....	.....	.....	.....	.....	.....	5	6	51	.....	.....	51	66	56	72
Dist. 2 Middle Gulf	3	2	2	1	.....	.....	.....	.....	.....	8	8	.....	3	19	4	2	5	3	.....	1	.....	.....	.....	15	14	22	.....	5	27	41	42	55
Dist. 3 Upper Gulf	2	1	.....	7	.....	.....	.....	.....	.....	10	19	.....	2	31	4	3	1	12	1	.....	1	1	1	24	29	39	.....	7	46	70	70	99
Dist. 4 L. Gulf-SW	2	1	1	9	.....	.....	.....	.....	.....	13	22	.....	.....	35	6	3	6	15	.....	1	.....	.....	.....	31	24	64	.....	3	67	109	98	133
Dist. 5 E. Central	.....	.....	.....	.....	.....	.....	1	.....	.....	1	3	.....	.....	4	.....	.....	.....	.....	.....	.....	1	.....	.....	1	2	17	.....	.....	17	14	18	16
Dist. 6 Northeast	1	.....	.....	1	.....	.....	1	.....	1	4	8	.....	1	13	2	1	.....	1	.....	.....	1	.....	1	6	6	26	1	3	30	11	36	17
Dist. 7-B N.Central	10	.....	1	3	.....	.....	2	.....	.....	16	47	.....	1	64	23	1	4	3	.....	.....	4	.....	.....	35	48	128	.....	10	138	122	173	170
Dist. 7-C W. Cent.	3	.....	.....	.....	.....	.....	2	.....	.....	5	20	.....	1	26	5	1	.....	2	.....	.....	5	.....	.....	13	4	51	.....	7	58	9	71	13
Dist. 8 West	9	.....	.....	3	.....	.....	5	.....	.....	17	23	.....	1	41	14	.....	.....	9	.....	.....	10	.....	.....	33	21	70	.....	9	79	34	112	55
Dist. 9 North	1	.....	3	1	.....	.....	4	.....	.....	9	58	.....	3	70	11	1	7	3	.....	.....	11	.....	.....	33	36	150	.....	11	161	95	194	131
Dist. 10 Panhandle	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	1	1	4	.....	.....	4	1	5	2
Utah	.....	.....	.....	1	.....	.....	.....	.....	.....	1	2	.....	.....	3	.....	.....	.....	1	.....	.....	.....	.....	.....	1	1	4	.....	.....	4	5	5	6
Virginia	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Washington	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	1	.....	1	.....
West Virginia	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3	.....	.....	.....	.....	.....	.....	3
Wyoming	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	6	.....	.....	6	1	.....	.....	1	.....	.....	.....	.....	.....	2	9	19	1	2	22	28	24	37
Total U. S.	59	5	11	30	2	1	25	1	4	138	469	.....	13	620	156	18	34	71	3	4	64	3	7	360	340	1364	4	69	1437	1252	1797	1592

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considerable gain in total, but actually about the same when reduced to a daily average basis. In fact, in each of the year's first three months, exploratory completions averaged 20 wells per day.

The number of wells completed as producers in March was substantially higher than was the case in the two preceding periods. Out of the total drilled, 138 were recorded as successful for a score of 22.3 percent. February's record was 94 producers, or 17.4 percent of the total drilled, and January's score amounted to 20 percent.

Exploratory wells completed in the first three months of 1950 totaled 1797, for a gain of 12.9 percent over the 1592 wells of last year's comparable period. However, this year's productive tests totaling 360 amounted to only 20 percent of the total drilled, while 340 a year ago amounted to 21.4 percent of those completed.

So far this year 227 oil pools have been located by this stepped-up exploratory campaign, while last year's had contributed 216 by the same time. These new pools were made up of 156 new fields this year against 155 a year ago and 71 new oil horizons in established fields compared with last year's 61. Major extensions to existing oil fields numbered 64 this year and 56 in 1949.

Discoveries of distillate pools have not been as numerous so far in 1950 as they were a year ago, being 21 to 33. Those were made up of 18 new distillate fields compared with 17 in 1949, but the difference occurred in the number of new pay strata in old fields. Only three have been found in 1950, while last year at the same time 16 had been tapped. Only three distillate fields received major extensions in each of the two periods.

Exploration for gas was slightly more successful this year than last, resulting in 38 discoveries against 31. Thirty-four of this year's finds were new fields and four were new pay horizons. Last year 26 were new field discoveries and five were new pays. Seven gas fields were extended, while only one had been enlarged by the end of March, 1949.

So far in 1950, rank wildcats outnumbered those drilled a year ago, but they did not account for quite as large a part of the total exploratory wells. These tests numbered 1572 or 87.5 percent of the total, while in 1949 they totaled 1432 to make up 89.9 percent of exploration activity. These figures show that the current program has placed a little more emphasis on outposts and new pay tests.

Successful wildcats totaling 208 were drilled in the first quarter of 1950, and those amounted to 13.2 percent of the total. That was slightly less than the 13.8 percent scored a year before, but it was considerably above average. In the previous 13 years, the average wildcatting success rate was 11.3 percent.

New Oil, Distillate and Gas Fields and New Pay Horizons Discovered in the United States in March, 1950

Also Important Extensions to Established Fields

COUNTY	FIELD	COMPANY, WELL AND LOCATION	Date Completed	Total Depth (Feet)	Completion Horizon (Feet)	[1]Name, Character and Age of Producing Formation	[2]Initial Production Method and Choke	Gravity of Oil
		CALIFORNIA—New Oil Fields						
Kern	Tejon Flats	C. A. Fickle & Doyle Wattenbarger's "Well" 1, 882 s, 668 w fr ne cor. Sect. 15-11n-18w.	3- 9-50	636	432- 482		P 28	28.8
San Bernardino		Royalty Service Corp., Ltd's Well 32-1, 965 n 540 e fr S¼ cor. Sect. 32-2s-8w. 5 mi se Chino.	3-16-50	1944	1650- 1700		P 24	24
Ventura		John McQuaid's Tapo 1, 1830 s 1175 w fr ne cor. Sect. 13-3n-18w. Midw betw Tapo Canyon and Simi flds.	3-10-50	542	367- 542		P 35	22.6
		CALIFORNIA—Oil Field Extensions						
Fresno	Guijarral Hills	Standard Oil Co's "27 F" 378, 330 n 990 w fr se cor Sect. 27-20s-16e, N. ext.	3-26-50	8234	8174- 8231	Allison sd; Mio.	F 314; ¾"	38
Kern	Fruitvale	Campbell & Shell's Kernland 7, 3310 s 330 e fr nw cor. Sect. 35-29s-27e. SE. extension.	3-17-50	4250	3902- 4000	U. Kernco sd; Mio.	P 60	18
Los Angeles	Aliso Canyon	Union Oil Co's Mission-Adrian 2, 4548 s 2819 e fr Sta. 84, Sect. 34-3n-16w. SE extension.	3-21-50	7580	7311- 7321	Sesnon sd; Mio.	P 62	26
		CALIFORNIA—Gas Field Extension						
Sacramento	Rio Vista	Brazos O&G Co's Langhart-Spreckles 2, 2805 n 1125 w fr se cor. Sect. 23-4n-3e. ½ mi ne extension.	3-10-50	4677	4541- 4584	Midland sd; Eoc.	F 4.3 mln; ⅝"	....
		ILLINOIS—New Oil Fields						
Clay	Oskaloosa	The Texas Co's C. T. Gabbert 1, NW NE NW 35-4n-5e, 3½ mi s of prod.	3-21-50	2891	2595- 2600	Bethel sd; Miss.	P 5; 13 wtr	....
Wayne	Orchardville	O. Henson Drlg. Co's Richison 1, NE SE SE 29-1n-5e, 2½ mi s of Zenith S. pl.	3-21-50	2906	2901- 2906	McClosky li; Miss.	P 22	....
		ILLINOIS—New Oil Pays						
Wabash	Maud, N. Cons.	Dale Hopkins's G. Wirth 1, SE SE NE 18-1s-13w	3-21-50	2672	2115- 2131	Tar Springs sd; Miss.	P 190	....
White	Centerville, E.	Fox & Fox's Barbre-Williams 2-A 3000 fr nl, 2970 fr el, Sect. 18-4s-10e	3-14-50	2239	2224- 2227	Palestine sd; Miss.	P 100; 50 wtr	....
		ILLINOIS—Oil Field Extensions						
Edwards	Albion Cons.	Calvert & Willis & W. Duncan's G. R. Evans 1, NE SE NE 2-3s-10e, ½ mi w extension.	3- 7-50	1990	1962- 1987	Biehl sd; Penn.	P 113	....
Effingham	Louden	M. H. Richardson's R. Lily 1-A, NE NE NE 18-8n-4e, ¾ mi e extension.	3- 7-50	1590	1579- 1587	Cypress sd; Miss.	P 10; 30 wtr	....
Jefferson	King	Magnolia Pet Co's O Taylor 1, NE SE NE 21-3s-3e, ¾ mi n extension.	3-28-50	2716	2705- 2714	Aux Vases sd; Miss.	P 46	....
Richland	Clay City-Noble Cons.	N. C. Davies et al's B. Wilson 1, 430 fr sl 330 fr wl NW SW 4-4n-10e, 1½ mi e extension.	3- 7-50	2985	2889- 2897	McClosky li; Miss.	P 9; 9 wtr	....
Wabash	New Harmony-Keensburg Cons.	C. E. Skiles' E. Schmidt 1, 990 fr sl 1515 fr wl SW¼ 18-2s-13w, 1 mi ext.	3-21-50	2901	2815- 2822	Rosi Clare li; Miss.	P 100	....
		INDIANA—New Oil Fields						
Dubois		B. & J. Development Co's J. F. Hochgesand 2, SW SW NE 7-2s-4w, 2 m se Jasper. 18 mi fr prod.	3-24-50	689	669- 683	McClosky li; Miss.	P 20; 5 wtr	....
Gibson		Geo. Pappas & Aurora Gasoline Co's Sam H. Nelson 1, SW SW NE 3-2s-10w, 2 mi e Princeton pl.	3- 7-50	1749	1740- 1745	Cypress sd; Miss.	P 52; 240 wtr	....
Perry		Robert Jarobe's Arthur Harth 1, SE SE SE 32-5s-3w, 2 mi n of E. Troy pl.	3-18-50	573	467- 494	Jackson sd; Miss.	P 15; 10 wtr	....
		KANSAS—New Oil Fields						
Ellis	Dechant	Lindas Oil Co. & Aledo O&G Co's Dechant 1, SW SW SW 6-15s-18w, 1½ mi se Antonio Townsite pl.	3-23-50	3683	3675- 3677	Arbuckle li; Ord.	P 78	....
McPherson		Texas Pacific Coal & Oil Co's Krehbiel 1, SE SW SW 11-20s-3w, 1 mi se Doorstep pl.	3-24-50	3056	3043- 3053	Mississippian li; Miss.	P 21; 80 wtr	35
Reno	Albion, N	Cities Service Oil Co's Graber 1, NW NW NE 14-26s-6w, 1 mi n of albion pl.	3- 8-50	4166	3977- 4002	Viola li; Ord.	P 15; 120 wtr	....
Rice	I X L	Lewis Drlg. Co et al's Schmidt 1, NE NE SW 4-19s-10w, 1½ mi sw Ringwald pl.	3-13-50	3335	3308- 3335	Arbuckle li; Ord.	P 135	....
Russell		Franco Central Oil Co & G. W. Davis's Kortman 1, SW SW NE 22-12s-14w, 1½ mi ne Claussen fld.	3-22-50	3280	3006- 3008	Lansing li; Penn.	P 462	39
Stafford	Hazel, W	Petroleum, Inc's Koopman 1, NE NW NE 2-21s-13w, 1½ mi nw of Hazel pl.	3-26-50	3679	3673- 3679	Arbuckle li; Ord.	P 311	....
		KANSAS—New Gas Field						
Butler	Andover, S	W. L. Hartman's Pray 1, SE NW SW 31-27s-3e	3-22-50	3112	2006- 2030	Stalnaker sd; Penn.	2.0 mln	....

[1] Character of producing formations abbreviated thus: ch, chalk; dolo, dolomite; li, limestone; sd, sandstone; sh, shale; ser, serpentine; cgl, conglomerate. Ages of formation abbreviated thus: Plio, Pliocene; Mio, Miocene; Olig, Oligocene; Eoc, Eocene; U. Cre, Upper Cretaceous; L. Cre, Lower Cretaceous; Jur, Jurassic; Tri, Triassic; Perm, Permian; Penn, Pennsylvanian; U. Miss, Upper Mississippian; L. Miss, Lower Mississippian; Devo, Devonian; Sil, Silurian; Ord, Ordovician; Cam, Cambrian.

[2] Barrels of oil per day (24 hour rate), flowing (F), pumping (P), swabbing (Sw), or bailing (B); or million cubic feet of gas daily open flow capacity; size of choke in inches.

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		KENTUCKY—New Gas Field						
Daviess		F. M. Ashby's Louis May 1, SW SE 11-O-31, 1½ mi ne of Cane Run pl., 1 mi w of Whiteside pl.	3-24-50	942	929- 942	Cypress sd; Miss.	1.5 mln.	
		NORTH LOUISIANA—New Distillate Pays						
Claiborne	Athens	Gulf Refining Co's Mamie M. Kinnebrew 1, NE NE 26-20n-7w	3- 9-50	11513	8208- 8233	Davis sd; Jur.	257; 30 mln; 32/64"	62.1
Claiborne	Athens	Skelly Oil Co & Sunray Oil Co's Conway-Gandy 1 1980 fr sl 1970 fr wl, 25-20n-7w.	3-24-50	9076	5176- 5204	Hill sd; L. Cre.	24; 4.3 mln	61.6
		NORTH LOUISIANA—New Gas Pay						
De Soto	Logansport	Skelly Oil Co's J. M. Fonville 1, Sect. 10-12n-16w, on nw flank.	3-16-50	6900	3065- 3076	Paluxy sd; L. Cre.	1 mln; 8/16"	
		SOUTH LOUISIANA—New Oil Fields						
Calcasieu		The Ohio Oil Co's E. W. Brown Jr. 1, 660 fr s&el Sect 20-11s-13w. 5 mi nw Black Bayou fld.	3-19-50	9912	7781- 7782	Brown "A" sd; Mio	F 292; 5/32"	43
Pointe Coupee		The Texas Co's Lillie Boudreaux et al 1, Sect 30-5s-8e, 1½ mi nw Fordoche fld, 2 mi w Lottie Twst.	3- 9-50	10002	7981- 7986		F 206; 1/8"	38.8
St. Mary		Sun Oil Co's State Lse 1337-1, 4200 s of nw cor Sect. 10-17s-12e. Sweet Bay Lake area.	3-22-50	11775	10051-10056		F 120; 7/64"	36
		SOUTH LOUISIANA—New Oil Pay						
Plaquemines	Black Bay	Gulf Refining Co's La. St. Lse 195 "QQ" 5, 14150 n 7160 e fr sw cor Twp 17s-17e.	3- 9-50	11503	10420-10430		F 186; 1/8"	39
		SOUTH LOUISIANA—Oil Field Extension						
Iberia	Weeks Island	Gulf Refining Co's Provost-Cyr Unit 1, 660 s alg el of Sect 19-14s-7e 1¼ mi se extension of deep prod.	3-13-50	13786	13396-13418		F 335; 5/32"	34.1
		SOUTH LOUISIANA—New Distillate Field						
Cameron		Magnolia Pet. Co's St. Lse 1120, A-1, 2352 s 108 w of ne cor Sect 11-15s-11w. Gulf of Mexico.	3- 1-50	10940	10806-10814		F 27; 3.9 mln; 7/32"	48.5
		MICHIGAN—New Oil Field						
Muskegon		Mercer Oil Co. Inc's Knitter 1, SW SW SE 23-11n-15w, Cedar Creek Twp.	3- 3-50	2449	1948- 1959	Traverse li; Devo.	P 20	
		MISSISSIPPI—New Oil Field						
Adams		Humble O&R Co's Alberta Robinson et al 1, 20-5n-3w, 1½ mi nw Ellislie fld.	3- 2-50	7116	6404- 6410	Armstrong sd; Foc.	P 162	29.1
		MISSISSIPPI—Distillate Field Extension						
Jasper	Sharon	Union Producing Co's Lee Chancellor et al 1, 1250 fr nl 50 fr el Sect. 20-10n-11w. 2 mi ne extension.	3-17-50	5777	5567- 5605	Stanley sd; Cre.	no gge; 1.6 mln; open	
		NEBRASKA—Gas Field Extension						
Cheyenne	Huntsman	Ohio Oil Co's Orian Mather 1, NW SW NW 12-14n-50w, 1½ mi nw ext.	3- 8-50	4915	4800- 4820	Third Dakota sd; U. Cre.	8.5 mln.	
		NEW MEXICO—New Oil Field						
Lea		Continental Oil Co's Warren 2-B-28, 1980 fr s&el of Sect. 28-20s-38e	3-12-50	9072	6767- 6804	Drinkard sd; Perm.	F 197	33
		NEW MEXICO—Oil Field Extension						
Lea	Roberts	C. T. McLaughlin & Cosden Petroleum Co's C. T. McLaughlin 1, 660 fr nl 1980 fr el 4-17s-32e, ¾ mi w extension.	3-15-50	4745	4165- 4745	San Andres li; Perm.	P 5	36
		OHIO—Gas Field Extension						
Athens	Stewart	B. H. Putnam et al's John P. Griffin 1, Fr. 3, Troy Twp, 2½ mi e of Coolville	3- 1-50	4170	3709- 4014	Ohio sh; Devo.	0.4 mln.	
		OKLAHOMA—New Oil Fields						
Cleveland	S.W. Clothier	Herman Brown's Seiter 1, NW NW SW 29-10n-2w, 5 mi s Moore	3-14-50	7408	7340- 7408	2nd Wilcox sd; Ord.	F 120; 5/32"	56
Garvin		W. E. Steelman's V. Baldwin 1, SE NE NE 34-1n-1e, 2½ mi se Hoover N. W. pl.	3-25-50	2542	2490- 2542	Deese sd; Penn.	F 70	34
Grant		J. A. Chapman's McKan 1, NE SW NE 14-8n-8e, (OWDD)	3-12-50	3360	3330- 3337	Cromwell sd; Penn.	F 10; 3/4"	
Jefferson		Sun Drilling Co's Samuel 1, SW SE SE 20-6s-5w, ne of Spring pl.	3- 1-50	1900	1881- 1900	Arbuckle li; Ord.	P 90	36
Jefferson		Sun Drilling Co's W. D. Seay 1, NE SE SE 22-6s-5w, 2¾ mi e Spring pl.	3- 1-50	2671	2509- 2530	Sand; Ord.	P 70	36
Payne		Claud Morgan's Mooreman 1, SE SE NW 31-18n-2e	3-11-50	5098	4330- 4350	Skinner sd; Penn.	P 25; 4 wtr.	
Stephens		Stanolind O&G Co's P. B. Truitt 1, SE SW NW 12-2s-4w, Milroy area	3-12-50	5256	4254- 4282	Springer sd; Penn.	P 9	21
		OKLAHOMA—New Oil Pay						
Lincoln	Happy Hill	Davon Oil Co's Jordan 1, SW NW NW 9-13n-3e, ½ mi fr prod.	3- 4-50	4725	4156- 4194	Oswego li; Penn.	F 14; 55 wtr	
		OKLAHOMA—New Gas Field						
Kay		Russell Maguire's Hutchinson 1, NE NW NW 20-27n-2e	3- 3-50	3754	608- 614	Foraker sd; Penn.	2.4 mln.	
		TEXAS—District 1 (SOUTH CENTRAL)—New Oil Field						
Bexar		C. J. Brown's W. A. Petty 1, 1850 fr el 8700 fr sl J. H. Pickens Sur. 7, 5 mi sw Lytle.	3-18-50	1482	1235- 1482		P 13	32
		TEXAS—District 1 (SOUTH CENTRAL)—New Gas Field						
Uvalde		Phillips Pet. Co's F. T. Kincaid 1, 1725 fr el 1450 fr sl Hipolito Sotello Sur. 377. 25 mi se Uvalde.	2-10-50	1790	855- 885		0.8 mln; open	
		TEXAS—District 2 (MIDDLE GULF)—New Oil Fields						
Goliad		Hugh Kirkpatrick's Mrs. Mary Lutenbacker 1, 4800 fr sel 4100 fr nel of Sampson McTornall Sur. 1 mi s Berclair gas fld.	3-10-50	3623	3194- 3200	Basal Frio sd; Olig.	F 98; 5/32"	27
Karnes		Edwin B. Cox & Jake L. Hamon's A&L Schoore 1, 400 fr swl & 467 fr sel of 181-ac. lse, Victor Blanco Sur. ½ mi w Runge fld.	3-26-50	6762	6545- 6546	Wilcox sd; Eoc.	F 139; 1/8"	37.2
Victoria	Minnita	Minnie S. Welder's Fee 5, 3264.69-ac. Lse., Phillip Dimmitt Sur. 3 mi se Victoria.	3-23-50	5360	4952- 4966		F 63; 1/8"	
		TEXAS—District 2 (MIDDLE GULF)—New Oil Pay						
Victoria	Placedo (Old)	J & C Drilling Co's Agnes West 5, 960 fr nwl 330 fr nel Blk 16, W. Rupley Sur.	3-22-50	6055	5443- 5446		F 144; 8/64"	28
		TEXAS—District 2 (MIDDLE GULF)—New Distillate Fields						
Jackson		Sohio Petroleum Co's L. M. Nyegaard et ux 1, 500 fr nel 4350 fr sel W. D. Southerland Sur. 2 mi n Sterling gas fld.	2-18-50	6728	6414- 6421		43; 3.0 mln; 18/64"	53.2
Jackson	"Swan Lake"	Southern Mineral's G. T. Brooking et ux 1, Josiah H. Bell Sur 4 mi se Vanderbilt fld.	3-29-50	9027	6003- 6033		no gge; 15 mln; open	
					6848- 6852		no gge; 5.8 mln; open	
		TEXAS—District 2 (MIDDLE GULF)—New Distillate Pay						
Bee	Plummer, S.	Midstates Oil Corp's Willis A. Robertson 1, 2050 fr nwl 660 fr nel T. B. Barton Sur.	2-18-50	7059	7016- 7026	Massive Wilcox sd; Eoc.	No gge; 22 mln; open	
		TEXAS—District 2 (MIDDLE GULF)—New Gas Field						
Bee		Bridwell Oil Co's F. V. Thomas 1, 467 fr s&wl John Kelly Sur. 15 mi nw Woodsboro.	3- 2-50	5610	4137- 4140		9.6 mln; open	
Jackson		H. J. Porter's Rudolph Yaussi Est. et al 3, 550 fr sel 4150 fr swl of sw'ly portion of John McWhite Sur. 1 mi sw Cordele fld.	2-13-50	2796	2725- 2727		72 mln; open	
		TEXAS—District 3 (UPPER GULF)—New Oil Fields						
Harris		Sun Oil Co's Williamson 1, 1320 fr el 1470 fr nl H&TC Sur. 19, 1½ mi ne of N. Delhi fld.	3-25-50	7765	6486- 6489		F 21; 11 wtr; 1/4"	41.8
Orange	Rose City	John W. Mecom's East Beaumont Townsite Co. 1, 1061-ac Lse, W. Stephenson Lge, 6 mi e Beaumont.	2-23-50	9051	8122- 8128	Hackberry sd; Olig.	F 279; 8/64"	39.7
		TEXAS—District 3 (UPPER GULF)—New Oil Pays						
Fort Bend	Thompson, S.	Cecil Hagen's J. H. P. Davis 2, 1900 fr wl 330 fr sl of "B" Lse, Robert Peebles Sur, on s flank of fld.	3-14-50	5568	4325- 4335	Miocene sd; Mio.	F 125; 5/32"	25.5
Galveston	Gillock, S.	The Superior Oil Co's Fee 1, 1047-ac Lse, John W. Lytle Sur. On shore of Moses Lake.	3-30-50	11582	9035- 9053		F 255; 3/16"	38.6
Liberty	S. Liberty	L. M. Josey et al's Joseph Mitchell 17, 807 fr wl 899 fr sl of 160-ac. Lse, M. G. White Sur. ne flk.	3-30-50	6508	5880- 5914	L. Yegua "5EY" sd; Eoc.	F 232; 1/8"	37
Liberty	S. Liberty	Josey-Nelms-Halbouty's Myrtle Chambers 1, (OWDD), 48.79 ac. Lse, M. G. White Sur, ½ mi ne of nw flk prod.	3-19-50	6540	6274- 6332		F 200; 8/64"	39.6
Liberty	S. Liberty	Stanolind O&G Co's Frank Abshier 1, 8.02-ac Lse, M. G. White Sur.	3-22-50	6950	6836- 6854		F 156; 1/8"	38.7

[1] Character of producing formations abbreviated thus: ch, chalk; dolo, dolomite; li, limestone; sd, sandstone; sh, shale; ser, serpentine; cgl, conglomerate. Ages of formation abbreviated thus: Plio, Pliocene; Mio, Miocene; Olig, Oligocene; Ecc, Eocene; U. Cre, Upper Cretaceous; L. Cre, Lower Cretaceous; Jur, Jurassic; Tri, Triassic; Perm, Permian; Penn, Pennsylvanian; U. Miss, Upper Mississippian; L. Miss, Lower Mississippian; Devo, Devonian; Sil, Silurian; Ord, Ordovician; Cam, Cambrian.

[2] Barrels of oil per day (24 hour rate), flowing (F), pumping (P), swabbing (Sw), or bailing (B); or million cubic feet of gas daily open flow capacity; size of choke in inches.

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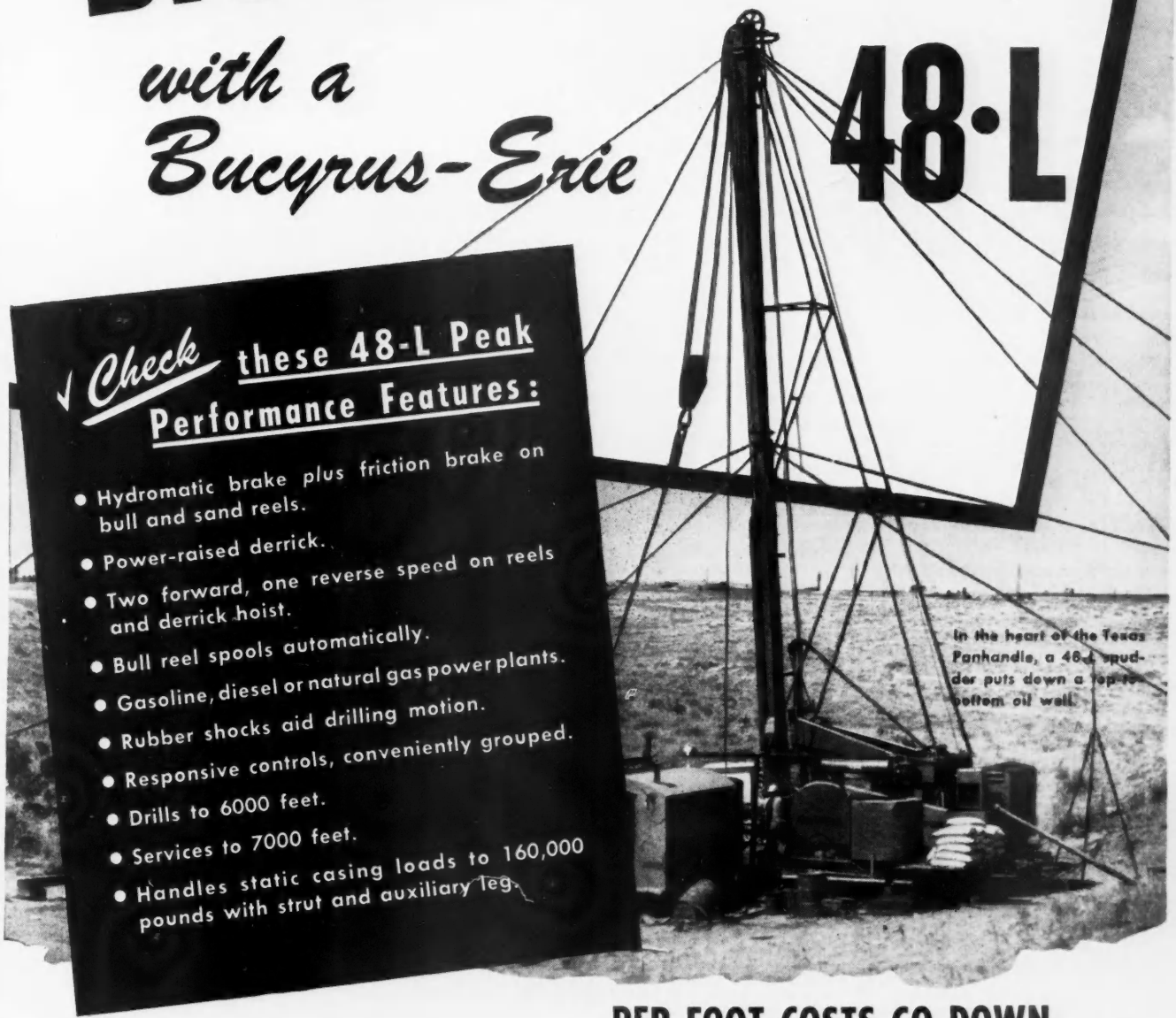

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- Bull reel spools automatically.
- Gasoline, diesel or natural gas power plants.
- Rubber shocks aid drilling motion.
- Responsive controls, conveniently grouped.
- Drills to 6000 feet.
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- Handles static casing loads to 160,000 pounds with strut and auxiliary leg.

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New Oil, Distillate and Gas Fields and New Pay Horizons Discovered in the United States in March, 1950

Also Important Extensions to Established Fields

COUNTY	FIELD	COMPANY, WELL AND LOCATION	Date Completed	Total Depth (Feet)	Completion Horizon (Feet)	[1]Name, Character and Age of Producing Formation	[2]Initial Production Method and Choke	Gravity of Oil
Orange	Pt. Neches	The Texas Co's Polk-Kuhn-Glass 4, 1560 s 109 e of sw cor of M. Beauchamp Sur, but in T. J. Notgrass Sur.	3-31-50	8075	6023- 6027		F 164; 3/32"	31.6
Wharton	Lissie	The Salt Dome Oil Corp. et al's Winnie M. Poole 1, 1270 fr nwl 660 fr swl GH&HRR Sur. 25.	3-23-50	7171	6370- 6378		F 59; 1/8"	33
		TEXAS—District 3 (UPPER GULF)—New Distillate Field						
Jefferson		Meredith, Clegg & Hunt et al's Mrs. Euphemia Burrell 1, 467 fr n&el Blk 7, John F. French Sur. 1½ mi se Hillebrandt Bayou fld.	3-16-50	8400	8282- 8295		39; 55 mln; open	61.6
		TEXAS—District 4 (LOWER GULF-SW)—New Oil Fields						
Duval	Rosalia, S.	Cox & Hamon & John F. Camp & Son's Driscoll A-2, 330 fr wl 990 fr sl Blk 54, Santa Rosalia Gr.	3-30-50	3365	3356- 3359		F 96; 3/16"	30.6
Duval	Seventy Six, S.	The Texas Co's Duval Co. Ranch NCT 54-1, 990 fr n&el of SW¼ of Gonzalo Garza Sur. 76. ½ mi s Seventy-Six fld.	3-18-50	2548	1710- 1720	Chernosky sd; Eoc.	P 50	25.5
		TEXAS—District 4 (Lower GULF-SW)—New Oil Pays						
Brooks	Alta Verde	H. L. Hawkins' Singer Est. 1, 330 fr sl 1650 fr wl C&MRR. Sur. 436	2-17-50	4273	4004- 4028	L. Vicksburg sd; Olig.	F 114; 3/16"	33
Hidalgo	Donna	Sinclair O&G Co's Foran Unit 1, 660 fr nl 330 fr wl of lot 14, Blk 15, Alamo Land & Sugar Co. Subd.	3-18-50	8560	6018- 6028		F 187; 1/4"	50.1
Hildalgo	Donna	Sinclair O&G Co's L. W. Shaffer 1, 660 fr n&s&wl of lot 9, Blk 16, Alamo Land & Sugar Co. Subd.	3-26-50	6959	6898- 6908	Frio sd; Olig.	F 185; 3/16"	45.6
Brooks	Kelsey-Deep	Humble O&R Co's McGill Bros. 143, 30,983.9-ac. Lse, La Blanca Gr.	3-19 50	8502	6308- 6318	U. Vicksburg sd; Olig.	F 70; 7/64"	37.1
Brooks	La Gloria	Fidelity Oil & Royalty Co's Otis Cosby 1, (OWWO), 660 fr n&e&wl of Lot 4, Blk 5, Falfurrias Fm & Gdn Trs. ⅔ mi s prod.	3- 3-50	9015	7542- 7547	Atlee "G" sd; Olig.	F 36; 1/8"	
Brooks	Rachal	Baldridge & King Inc's D. H. White 1, 467 fr n&el of Sh. 7, Partition of La Escantada & Encino Del Pozo Gr.	3-16-50	4894	4366- 4376		F 137; 1/8"	46
Kleberg	Canelo	Humble O&R Co's King Ranch-Canelo 2, 660 fr nl 3300 fr el CCSD&RGNG RR Sur. 310.	3-29-50	8823	6621- 6637		F 112; 1/8"	40.4
Nueces	Cement	Henshaw Bros. & O. R. Mitchell's H. R. Bryant 1, (OWWO), 330 fr s&wl of 88.28-ac. Lse, Sect. 45, Geo. H. Paul Subd. of Driscoll Ranch.	3- 7-50	6702	6196- 6201		F 47; 3/16"	39.6
Nueces	Mustang Island	The Atlantic Refg. Co's State Tr. 409-1, 660 fr sw&sel Tr. 409, Corpus Christi Bay.	2- 4-50	8000	7311- 7321		F 241; 5/32"	39.9
		TEXAS—District 4 (LOWER GULF-SW)—New Distillate Field						
Kleberg		Humble O&R Co's King Ranch-East Laureles G-3, 560 w 8580 s of se cor of Tr. 123, Rincon de Los Laureles Fm Trs. Laguna Larga area.	2-26-50	9992	6030- 6050		No gge; 90 mln; open	56
		TEXAS—District 4 (LOWER GULF-SW)—New Gas Field						
Zapata		J. C. McCabe's Cuellar Bros. 1, 990 fr sel 1650 fr nel of TCRR Sur. 245, 1 mi s Cuellar fld.	3- 1-50	1309	1146- 1150		2.0 mln; open	
		TEXAS—District 5 (E. CENTRAL)—Oil Field Extension						
Hopkins	Pickton	Magnolia Pet. Co's A. F. Payne 1, 467 fr sw cor of Ollen Odom Sur. 2 mi se extension.	3-21-50	7886	7857- 7864	Bacon li; L. Cre.	F 162; 5/32"	52.2
		TEXAS—District 6 (NORTHEAST)—New Oil Field						
Shelby		S. J. Carnes' W. A. Bridges 1, (OWWO), 525 fr ely el 1550 fr sly nl R. S. Forbes Sur. 6 mi e patroon.	3- 3-50	6015	3650- 3662	Georgetown li; L. Cre.	F 89; 3/16"	
		TEXAS—District 6 (NORTHEAST)—New Oil Pay						
Anderson	Blackfoot	The Texas Co's Standle A. Thompson et al unit 2-1, 3050 fr el 2500 fr nl of I. P. Rinehart Sur.	3-11-50	9225	9085- 9110	Rodessa li; L. Cre.	F 325; 1/4"	44
		TEXAS—District 6 (NORTHEAST)—Oil Field Extension						
Anderson	Tennessee Colony	Bering Company et al's Mary W. Hopkins 1, 800 fr nl 1600 fr wl A. G. Monrce Sur. ¼ mi se extension.	3-20-50	9029	8869- 8993	U. Rodessa li; L. Cre.	F 93; 1/4"	43.2
		TEXAS—District 6 (NORTHEAST)—Gas Field Extension						
Panola	Carthage	Skelly Oil Co's Frost Lbr. Co. B-1, 1320 fr el 1464 fr ely nl of Micher Carpenter Sur. 1½ mi w Logansport fld, (La.) e extension.	2-28-50	6324	6066- 6112	L. Pettit li; L. Cre.	5.2 mln; open	
		TEXAS—District 7-C (W. CENTRAL)—New Oil Fields						
Runnels		E. K. & E. M. Burt & D. F. Stephenson's Mrs. Malinda Jameson 2, 330 fr n&el of 200-ac. Lse, ETRR Sur. 118. ½ mi nw Talpa in Ogden-Mabee area.	3-31-50	3390	3388- 3390	Fry sd; Penn.	F 432; 3/8"	45
Runnels		Garland Anthony & G. W. Strake's W. P. Lloyd 1, 330 fr sl 4735 fr el of of Sect. 94, Hattie E. Baggs Sur 1¾ mi nw of N. Winters fld.	3- 9-50	4364	4345- 4357	Fry sd; Penn.	F 1391; 3/4"	45
Runnels		William Hamm, Jr. & Fred M. Manning, Inc's Charity Pace 1, 4263.8 fr wl 5358.3 from sl. Lela Forsythe Sur. 450. 1½ mi se Wingate.	2-28-50	5417	4442- 4465	Strawn sd; Penn.	P 7	41
		TEXAS—District 7-C (W. CENTRAL)—Oil Field Extensions						
Runnels	Fort Chadbourne	Hiawatha O&G Co. & Plymouth Oil Co's Tad Richards 1, 467 fr nwl 901.9 fr swl of G. Villareal Sur. 280. 1¼ mi s extension.	3-20-59	5302	5249- 5252	Strawn sd; Penn.	F 165; 3/16"	45
Upton		Republic Natural Gas Co., Norwood Drlg. Co. & Warren Wright's American Republics Corp. 1, 660 fr n&wl of Sect. 6, Blk 40, T-5-S, T&P Sur. 1¼ mi sw extension.	3-16-50	13160	13025-13160	Ellenburger li; Ord.	F 3183; 21/64"	54.6
		TEXAS—District 8 (WEST)—New Oil Fields						
Borden		Barnsdall Oil Co's W. L. Wilson 1, 660 fr n&el of Sect. 16, Blk 27, H&TC Sur.	3-31-50	7452	7410- 7452	Canyon Reef li; Penn.	F 1604; 1/2"	47.2
Borden		Seaboard Oil Corp. et al's Porter Hanks 1, 660 fr nl 1980 fr wl of Sect. 19, Blk 32, T-3-N, T&P Sur. 2 mi nw Vealmoore fld.	3- 2-50	8225	8167- 8185	Canyon Reef li; Penn.	F 218; 1/4"	43.6
Crane		The Texas Co's C. W. Hobbs NCT-2, 6-B, 1980 fr se&swl of Sect. 35, H&TC Sur. 3 mi s McCamey fld.	3- 6-50	5501	5085- 5110	Basal Permian li; Perm.	P 116	43.8
Gaines	"East Hobbs 5900"	Humble O&R Co's E. B. Bailey et al 1, 1980 fr nl 660 fr el of NW¼ of Sect. 6, Blk A-10, PSL Sur. 5 mi e Hobbs fld (N. Mex.).	3-18-50	6460	5845- 5855	San Angelo sd; Perm.	P 239; 33 wtr	36.5
Kent		Drlg. & Exploration Co., Inc. et al's Wilson Connell 1, 660 fr n&el of Sect. 19, Blk 5, H&GN Sur. 2 mi se Polar fld.	3-15-50	7931	2340- 2350	San Andres dolo; Perm.	P 12; 80 wtr	33
Midland		General American Oil Co's Josie Faye Peck 1-E, 660 fr n&wl of Sect 21, Blk 41, T-4-S, T&P Sur. 4 mi nw Pegasus fld.	3- 4-50	13397	13128-13246	Ellengurger li; Ord	F 1056; 1"	53.1
Midland		James H. Snowden et al's Andrew Fasken 1, (OWDD), 1980 fr n&el of Sect. 7, Blk 36, T-2-S, T&P Sur.	3- 6-50	7343	7128- 7343	Sprayberry sd; Perm.	F 70; 11/64"	40.5
Scurry		Castleman & O'Neil et al's Feldman-Pardo 1, 467 fr n&wl of SW¼ of Sect 651, Blk 97, H&TC Sur. 2 mi sw Cogdell fld.	3- 5-50	6883	6716- 6883	Canyon Reef li; Penn.	F 2782; 1"	42
Scurry		Progress Pet. Co. of Texas' O. R. Buffaloe 1, 467 fr s&el of SE¼ Sect. 565, Blk 97, H&TC Sur. 3 mi n of Snyder fld.	3- 3-50	6900	6787- 6900	Canyon Reef li; Penn.	F 436; 5/8"	41.5
Ector	Lawson-Simpson	Gulf Oil Corp's C. A. Goldsmith et al 542, 440 fr s&wl of NW¼ Sect. 45, Blk 44, T-1-S, T&P Sur.	3- 6-50	4340	4320- 4340	San Andres li; Perm.	P 70; 25 wtr	37.9
Garza	Anderson	P. W. & R. S. Anderson et al's J. S. Anderson 1-46, 330 fr n&el of SE¼ Sect. 46, Blk 6, H&GN Sur.	2-26-50	2443	2422- 2443	San Andres li; Perm.	P 84; 10 wtr	37
Pecos	Abell, N.W.	Geo. T. Abell's E. A. Hall 1-A-29, 330 fr wl 430 fr nl of Lot 5, Sect. 29, Blk 9, H&GN Sur.	3-18-50	2414	2395- 2414	San Andres li; Perm.	F 76; 2"	37.2
		TEXAS—District 8 (WEST)—Oil Field Extensions						
Ector	Lawson-Simpson	Atlantic Refg. Co's TXL 1-M, 1980 fr n&wl of Sect. 5, Blk 44, T-2-S, T&P Sur. 1¼ mi sw extension.	3- 8-50	5811	5474- 5526	San Angelo li; Perm.	P 163; 33 wtr	37.5
Gaines	Cedar Lake	Ted Weiner et al's J. O. Jones et al 1, 660 fr n&el of NW¼ Sect. 2, Blk H. D&W Sur. 2 mi n extension.	3-14-50	4847	4760- 4847	San Andres li; Perm.	F 83; 2"	34
Gaines	Harris	The Texas Co's J. Tetens 1, 660 fr n&el of Sect. 16, Blk A-22, PSL Sur. 1 mi w extension.	2-23-50	7435	5940- 5960	Glorietta li; Perm.	P 109	30.6
Midland	Tex-Harvey	Harry B. Lake et al's J. H. Floyd 1, 666.7 fr sl 2028.16 fr el of Sect. 14, Blk 37, T-3-S, T&P Sur. 1¾ mi e extension.	3-16-50	7262	6988- 7262	Sprayberry sd; Perm.	F 242; 1/4"	37.2
Scurry	Sharon Ridge Canyon	Warren Oil Corp's J. M. Reynolds 1, 660 fr s&el of NE¼ of Sect. 101, Blk 25, H&TC Sur. 1¼ mi sw extension.	3-22-50	6708	6555- 6705	Canyon Reef li; Penn.	F 2694; 1"	47
		UTAH—New Oil Pay						
Uintah	Ashley Creek	Stanolind O&G Co's USA 10, SE SW SE 22-5s-22e	2-20-50	4330	4212- 4330	Phosphoria sd; Perm	F 60; 5/64"	

[1] Character of producing formations abbreviated thus: ch, chalk; dolo, dolomite; li, limestone; sd, sandstone; sh, shale; ser, serpentine; egl, conglomerate. Ages of formation abbreviated thus: Plio, Pliocene; Mio, Miocene; Olig, Oligocene; Eoc, Eocene; U. Cre, Upper Cretaceous; L. Cre, Lower Cretaceous; Jur, Jurassic; Tri, Triassic; Perm, Permian; Penn, Pennsylvanian; U. Miss, Upper Mississippian; L. Miss, Lower Mississippian; Devo, Devonian; Sil, Silurian; Ord, Ordovician; Cam, Cambrian.

[2] Barrels of oil per day (24 hour rate), flowing (F), pumping (P), swabbing (Sw), or bailing (B); or million cubic feet of gas daily open flow capacity; size of choke in inches.

Relative Economics of DIAMOND Coring and Drilling

By C. DEELY

President, Drilling & Service, Inc.

FIGURE 1. Typical Congo bortz bit, available with or without waterways.

THE STORY of diamonds giving the origin, types, uses, etc., has been comprehensively presented in former articles and talks.[1,2,3,4,5] However, the possible effect of the various types of diamonds and their qualities on the relative economics of diamond coring compared to conventional coring and drilling has not been discussed.

Of the several kinds and types of diamonds produced, the Congo and West African bortz are now the most common to the oil field bit. Although other types are occasionally mixed with the Congo and West African, reference will be made only to these two types for the purpose of this paper. Until now these two types have not been distinguished and described so that the industry will know what it is buying and the probable economy of each.

The name bortz includes all diamonds that are not usable as gem stones; therefore, all diamonds set in oil field bits are bortz. The Congo is a bortz diamond deriving its name from the area, Belgian Congo, in which it is mined. The West African bortz also derives its name from the area in which it is mined.

While the technical literature does not specifically cover the ratio of hardness and specific gravity between the two types, yet there is this difference in their structure: the West African bortz has lines of cleavage, while the Congo bortz, which is a conglomerate mass, has not. Therefore, the West African bortz is subject to a breakage in the cleavage planes, while the Congo is not. For this reason some authorities believe a mixed bortz bit gives the best performance. The fine crystalline structure of the Congo and the frequent changes of direction of the grain structure will often allow the point of the diamond to crumble, making it subject to an apparent wear and at the same time appear to the unitiated to be softer than the West African bortz. On the other hand, it will stand shock better than the West African bortz.

Identifying Bits

Diamond bits are identified according to the diamonds set therein. The two types of diamonds are set in three kinds of bits and, in general, are sold to the industry under the trade names of Congo, West African and Bortz. The Congo bit contains Congo bortz (Figure 1); the West African bit contains West African bortz; the Bortz bit simply contains a mixture of good quality Congo and West African bortz (Figure 2). The price per carat of the all-Congo bit is usually less than the price per carat of the West African or Bortz bit, which appears to have given the oil industry the impression that the word Congo means a diamond of inferior quality as compared to the West African bortz. This is not necessarily true, because a high as well as a low quality Congo is mined.

The West African and Bortz bits are usually set with diamonds ranging in size from six to ten stones per carat. In sizes larger than this, the cost per carat of good quality West African bortz usually rises rapidly because of uses in the diamond tool industry. Congo bortz in the larger sizes does not command such prices, due to the law of supply and demand. Consequently, when the large stone bits are required for certain drilling conditions, Congo bortz ranging in size from one-fourth to 1 stone per carat is used. It is very effective for this purpose.

Diamond cost is based on carat weight plus a manufacturing charge. The carat weight varies with each bit; therefore, the total cost varies with each

DIAMONDS FIRST FOUND a place in the oil industry as a means of higher core recoveries to better evaluate reservoir information and electrical log interpretations. Today, diamonds are used not only to obtain high recoveries, but also as an economical means of making hole. Diamonds have taken a permanent place in the oil industry and their use is rapidly increasing with time. The economics of diamonds merit consideration when high core recoveries are required or the drilling is tough. This article is from a paper presented at the Mid-Continent District meeting of the Production Division, API, Oklahoma City, March, 1950.

bit. When extremely hard formations are anticipated, bits are often set with a greater diamond concentration for better performance. Higher concentration of diamonds increases the initial investment, but the salvage value after use is usually of higher proportion, resulting in about the same net cost. The quality of the diamonds set in the bit determines the cost per carat, currently ranging from $5 to $12.50 per carat.

Quality Diamonds

Theoretically, when a higher quality diamond is used, better performance and lower cost per foot are effected, particularly in the harder formations. However, this theory does not always hold true. In general, it appears that the quality of diamonds currently selling for approximately $9.50 per carat is giving optimum results in all formations, although at this time, experimental work with a lower quality and cheaper diamond is being conducted. Results to date indicate that these diamonds will do satisfactory work in specific formations at a reduced cost per foot. It is possible that as these experiments progress, the industry can look forward to a substantial reduction in diamond drilling cost in other areas.

All diamonds are purchased through dealers, brokers, or from the outlet established by the Diamond Syndicate in London and regardless of all claims to the contrary, the syndicate is not in the retail business. After purchase, the diamonds are sorted as to size and quality for their various uses in industry, one of which is oil field use. Some bit manufacturers buy diamonds sorted ready for setting in the bit. Others buy unsorted lots and do their own sorting.

The sorting of diamonds is done by careful visual inspection and is based upon knowledge gained through long years of experience in the diamond industry. Each company established its own standards of quality; however, in general, all reputable companies have comparable standards of stone size, quality and price. Due to the closely controlled diamond market by the syndicate, one dealer cannot materially undersell another regardless of buying power. Therefore, since the size and quality determines the price of diamonds, purchasing them is like buying other merchandise. The purchaser gets reliability and performance in direct ratio to what he pays.

Although diamond drilling has been attempted periodically in oil wells for many years, the results were not successful until 1946, when Stanolind Oil & Gas Company introduced diamonds to the Rangely field.[1] While the first well cored at Rangely was not a great success, it was encouraging enough to merit further use. With the continued use of diamonds in the Rangely field, the manufacturers of diamond equipment were given a long needed opportunity to develop the diamond bit, core barrel designs and operating technique to the point of becoming successful, both as a means of obtaining high core recovery and materially reducing drilling costs.

First Success

Diamonds achieved their first great success in the Rangely field. However, it should be pointed out that this success was possible without much effort because the Rangely Weber sandstone and related conditions were perfect in every respect for good diamond performance. Had it not been for the toehold gained in the Rangely field, it is doubtful that diamonds would be in use in the oil field today. Soon after diamonds were proved a means of substantially reducing the drilling costs in Rangely, their use quickly spread into nearly every active field in the world; not, however, before further development.

When diamond drilling moved into areas away from Rangely, it was soon realized that the diamond equipment which had given excellent performance there would not give satisfactory results in the new areas, so it was redesigned for these new problems. The outstanding Rangely results encouraged the operators to continue diamond drilling in the new areas, although at the beginning the results were often disappointing and costly. This gave the diamond specialist and core barrel engineers an opportunity for further development of equipment.

Today, diamond coring is highly competitive with conventional coring. In many instances diamond coring reduces cost and with rare exceptions, the core recovery is 100 percent. Diamonds make it possible to take long cores per trip and this reduces the rig time, resulting in lower costs per foot. Also, the penetration rate of diamonds is usually faster than other core heads to further reduce the rig costs. The diamond bit cost per foot is not always lower than other core heads, and in such instances the entire saving is in reduced rig time plus all intangible daily expenses, such as mud, fuel, etc.

In many areas, extremely hard formations are encountered which can be diamond cored at a lower cost per foot than by conventional rock bit drilling. In such cases it is strictly a matter of

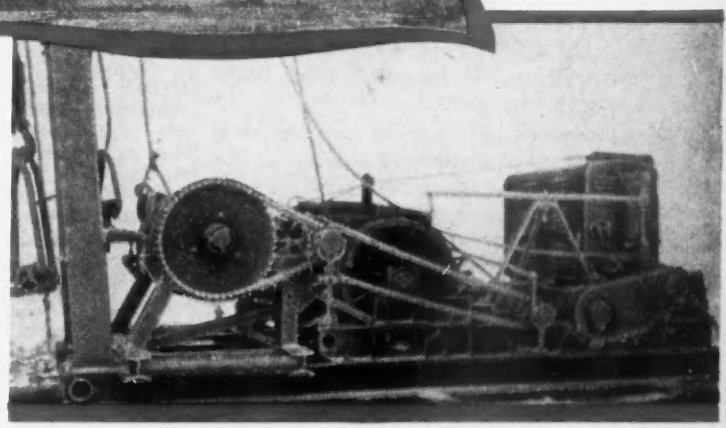
FIGURE 2. Typical bortz bit set with six to ten stones per carat.

REMEMBER . . . . . .

THAT BARBED WIRE FENCE BETWEEN AMARILLO AND THE NORTH POLE?

One strand of the fence was down most of the time. You laid a shingle against the North wall of the Doghouse in November. When the shingle fell, it was Spring. And Borger was so hot the Rangers had to clean it up!

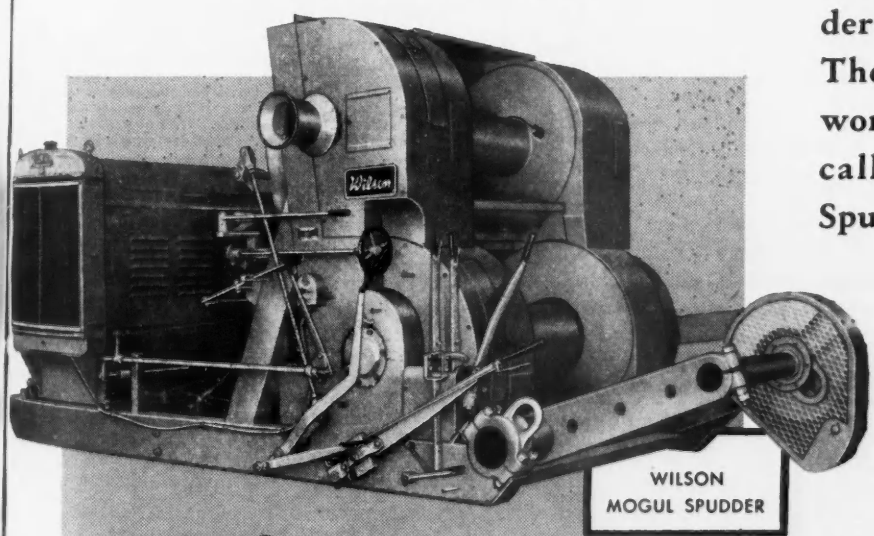
BUT Wilson WAS THERE!
AND WILSON WAS FIRST!



Above: An early WILSON Spudder at Borger, after a sleet storm. Then, as now, WILSON had the world's finest Spudder. Mechanically, it is a long way from the Spudder above to the one at left.

But WILSON is still first! First in design . . . First in quality . . . and First in durability!

COMPARE PRICES BEFORE YOU BUY!



WILSON
MOGUL SPUDDER

Wilson MANUFACTURING CO., Inc.
WICHITA FALLS, TEXAS

Pacific Coast Distributor: Power Rig & Equipment Co., Los Angeles, California • *Export Agents:* Daniels, Beckley and Associates, 30 Rockefeller Plaza, New York City • Langley y Cia, Corrientes 1115, Buenos Aires, Argentina — TA-35, Libertad 9535. W. C. Langley, Apartado Aereo 397, Barranquilla, Colombia, Phone 49-29 • Dufour Pere, Fils & Cie, 11, Rue Aspirant Dargent, Levallois-Perret (Seine) France • Cia Panamericana de Equipo, S.A. 741 Calle Coquimbo, Mexico, D.F., Mex. Phone L.D. 31.

economics without regard for the core. In this respect, diamonds have definite limitations and it is impossible to give a hard and fast rule as to when it would be most economical to start using diamonds. However, as long as a rock bit will drill 25 feet or more per bit it would probably be poor economy to use diamonds, but if the rock bit footage is less than 25 feet there is a definite chance that diamonds will reduce the drilling cost. When contemplating the use of diamonds strictly as a hole-making tool, consideration should be given to the nature of the formation from a fracture standpoint, because if it is badly fractured, core wedging may occur, preventing long cores. In this case, the rock bit may be the most economical tool.

Diamonds are often used to cut the extremely hard sections of a hole and rock bits used for the sections between. When this program is followed, a diamond bit from one-eighth to one-fourth inch smaller than the rock bit is usually used. This is done because a diamond bit will not always follow the same size rock bit without reaming; however, a rock bit from one-eighth to one-fourth inch larger than the diamond bit will pass through the diamond bit hole with little effort and no damage to the rock bit. The alternate use of rock bits and diamond bits, as just outlined, has been successfully practiced.

Diamonds have proved effective and economical as a rotary shoe when washing or drilling over a "fish" in hard formations where other standard shoes have failed; however, diamond rotary shoes are recommended only when other shoes will not do the job.

Whipstocking

Whipstocking is another use for diamonds. Several holes have been whipstocked when other means have failed. Recently, an operator had to whipstock a fish below 13,000 feet in a six-inch hole. A permanent type whipstock was set and 14 rock bits run, but they failed to take off in the lime and chert. A diamond core bit was run, which took off, cutting a core of the whipstock and formation (Figure 3). The same rule applies to whipstocking with diamonds as to the rotary shoe; diamonds should be used when the cheaper conventional means failed to do the job.

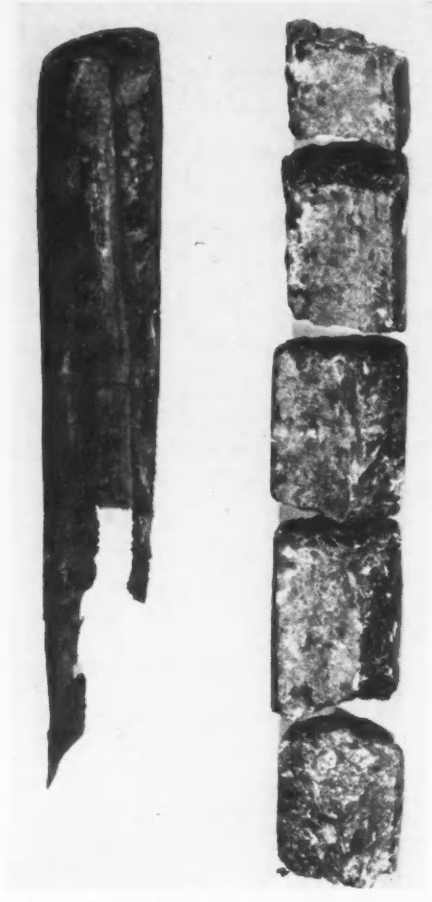


FIGURE 3. Core cut off a permanent type whipstock below 13,000 feet in six-inch hole. On the left is the portion of whipstock recovered with the lime and chert core on the right. The flat shoulder at the top of the piece of whipstock (right) resulted from the 14 rock bits used before diamonds. Note how the whipstock and core taper as the diamond bit cuts into the wall of the hole at about a five-degree angle.

In Table 1 will be found comparative cost data between full hole diamond coring and conventional drilling. It is classed as full hole because the diamond cut hole was not reamed. The cost data were furnished by the operators; however, for obvious reasons the well and operators are not identified. It is pointed out that all rock bit cost data are strictly an estimation based on drilling the same formations in offset wells and occasional drilling in the same hole between diamond coring trips. In computing the total costs, only the rig time and bit costs were used.

Diamonds are in wide use in all active areas as a means of obtaining high core recovery. The three examples in Table 2 are typical and all available cost data are given:

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[3] Swesnik, R. M., Diamond Coring an Oklahoma Well. World Oil, Vol. 128, No. 3, p. 92, July, 1948.

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TABLE 2

EXAMPLE 1:	
State	Louisiana
Field	Dave Haas
Formation	Wilcox
Feet Cored:	2653
Feet Recovered	2653
Hole Size	8½" (Open)
Cost—including rig time, mud, etc.	$20.03 per ft.
Diamond Bit Cost	3.37 per ft.
Rate of Penetration	4.16 ft. per hr.
Total Coring Time	55.75 days
EXAMPLE 2:	
State	Louisiana
Field	Dave Haas
Formation	Wilcox
Feet Cored	261
Feet Recovered	261
Hole Size	8½" (Open)
Wire line core head cost coring the same section in two offset wells	$10.65 per ft.
Diamond Bit Cost	15.12 per ft.
Savings per ft. on bit cost	$ 4.53
Wire Line Recovery	85 percent
Diamond Recovery	100 percent
EXAMPLE 3:	
State	Texas (South)
Field	Clear Creek
Formation	Wilcox
Feet Cored	1200
Percent Recovered	95.7 percent
Hole Size	6" (below 7" OD casing)
Conventional Core Head Cost	$13.00 per ft.
Diamond Bit Cost	2.85 per ft.
Savings per ft. on bit cost	$10.15

In the above hole 925 feet were diamond cored below the casing, then a whipstock was set in the casing and the hole sidetracked through the casing. 275 feet were cored in the sidetrack hole to the top of the 925 foot core hole.

TABLE 1

Cost Per Foot Comparison—Full-Hole Diamond Coring vs. Rock Bit Drilling

STATE	FORMATION	Hole Size	Feet Cored	Feet Recovery	Bit Cost per Ft.		Rig Cost per Ft.		Total Cost per Ft. Rig + Bit Cost		Estimate Days Saved	Estimate Net Dollar Saving
					Dia. Bit	Rock Bit	Dia. Bit	Rock Bit	Dia. Bit	Rock Bit		
Oklahoma	Bromides	8¾"	702′	697′	$16.30	$26.00	$57.69	$128.57	$73.99	$154.57	55	$56,567.06
Oklahoma	Bromides	8⅝"	346′	344′	25.43	13.56	40.46	67.93	65.89	81.49	9	6,798.40
Oklahoma	Bromides	8¾"	198′	198′	11.99	12.50	27.27	47.76	39.26	60.26	4	4,157.31
Oklahoma	Bromides	6"	659′	659′	5.21	12.78	47.80	75.11	53.01	87.89	20	22,991.65
Oklahoma	Bromides	8¾"	157′	157′	28.03	9.82	22.93	42.45	50.96	52.27	3	206.04
Oklahoma	Bromides	†6"	1208′	1196′	7.14	4.59	29.06	59.61	36.20	64.20	41	33,824.00
Oklahoma	Bromides	6⅛"	360′	360′	24.23	56.03	*	*	*	*	*	11,448.00
Wyoming	Tensleep	9"	508′	506′	19.53	70.00	*	*	78.53	113.47	*	17,749.42

† Cored through 7"—29 lb. casing; all other wells cored in open hole. * Data not available.

Factors Affecting Penetration Rate of Rock Bits

Part 1

By W. J. BIELSTEIN and GEORGE E. CANNON
Humble Oil & Refining Company

PRELIMINARY TESTS to determine the effect of various factors affecting the rate of penetration of rock bits are recorded in this paper. The importance of the number and design of cutting elements on rate of penetration is established in the limited tests. Findings were also made that the magnitude of the various effects on the rate of penetration varies with changes in the types of formation drilled. This paper, substantially as here presented, was read before the Spring meeting of the Southwestern District API Division of Production in Dallas, March, 1950.

IN A series of papers[1,2,3] presented by members of the staff of the Petroleum Engineering Division of Humble Oil & Refining Company in 1948 and 1949, it was shown that the rate of penetration with two-way drag-type bits was related to certain hydraulic factors. A mathematical analysis of these hydraulic factors showed that their effects on drilling rate could be reduced to generalized equations. Several excellent articles[4,5] on the factors affecting the rate of penetration of rock bits have been presented during the past few years. In general, however, the data presented were based on laboratory studies, using either full-scale or miniature bits to drill either a few inches or feet of hole.

The tests described in this paper were conducted in drilling wells. Every effort was made to select formations of uniform drillability and evaluate only one variable at a time. Because of the wide variation in the hardness or drillability of the formations normally drilled with rock bits, it will probably be impossible to reduce the factors affecting the rate of penetration to one set of generalized equations. However, laboratory data published in the past[4,5] and the data in this paper show that the operator can take advantage of numerous physical and hydraulic factors to increase the rate of penetration obtained with rock bits.

This investigation of the factors affecting the rate of penetration of rock bits was divided into three parts: (1) the effect of bit design from the standpoint of number of cutting elements and distribution of fluid with respect to the cutting elements and the bottom of the hole; (2) the evaluation of the hydraulic factors affecting the rate of penetration; and (3) the effect of rotary speed and bit weight on the rate of penetration. To date, tests have been confined to formations which might be classified as the softer rocks that, in most cases, cannot be economically drilled with drag bits, and to formations classed as medium hard and non-abrasive. In tests where other factors were investigated, the tooth design of the bit cutting elements was the same as for conventional bits used in drilling the particular types of formations.

Investigations in regard to bit design were confined essentially to bits having various numbers of cutting elements and modifications to change the distribution of circulating fluid at the bit. Several tooth designs of the cutting elements were investigated to determine the relative merits of the design.

Peg-Leg Rock Bits: The peg-leg bit, Figures 1 and 2, is essentially a conventional rock bit with one of the cutting elements removed. On the jet-type peg-leg bits, the cutting element was replaced with a high fluid-velocity nozzle for the purpose of changing the direction and flow characteristics of the circulating fluid at the bit. Two types of peg-leg bits were tested, viz., two- and three-cutting element bits. In each case, either a peg-leg bit with conventional water-courses or a conventional bit was run within the same test section. Typical test results are graphically illustrated in Figures 11 and 12. As may be noted, the two-cutting element peg-leg bit, with a high fluid-velocity nozzle directed to the bottom of the hole, drilled the Midway shale (a medium-hard formation) in the Mallalieu field, Mississippi, from 7500 to 8215 feet, 53 percent faster at 10,000 pounds bit weight and 36 percent faster at 20,000 pounds bit weight than did the conventional peg-leg bit with conventional water-courses and fluid distributed on the cutting element. The three-cutting element peg-leg bit with a single high

FIGURE 1. Peg-leg conventional rock bit with two cutting elements.

FIGURE 2. Peg-leg rock bit with three cutting elements.

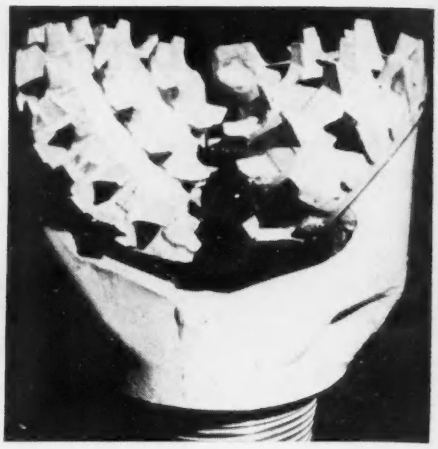

FIGURE 3. Bit "A," conventional rock bit with two cutting elements.

fluid-velocity nozzle directed to the bottom of the hole consistently drilled the Taylor shale (a soft formation) in the Pickton and Yantis fields, Texas, from 3000 to 3710 feet, at a lower rate than did the conventional four-cutting element bit with the fluid directed against the cutting element.

Two-Cutting Element Rock Bits: Four types of two-cutting element rock bits, as illustrated in Figures 3, 4, 5, and 6, were used on controlled tests to determine the comparative drilling characteristics of the two-cutting element rock bits with respect to fluid distribution. On each type of bit, the tooth design was selected on the basis of the formation to be drilled. The two-cutting element bits, as designed, had smaller bearing areas than did the three- and four-cutting element rock bits and were, therefore, generally tested using lighter bit loads. Test results on the two-cutting element rock bits are graphically illustrated in Figures 11, 12, and 13. The conventional design of Bit "A," illustrated in Figure 3, was modified to change the direction and characteristics of fluid discharge by installation of two high fluid-velocity nozzles directed to the bottom of the hole, as shown in Figure 4. In the Midway shale, a medium hard formation, in the Mallalieu field,

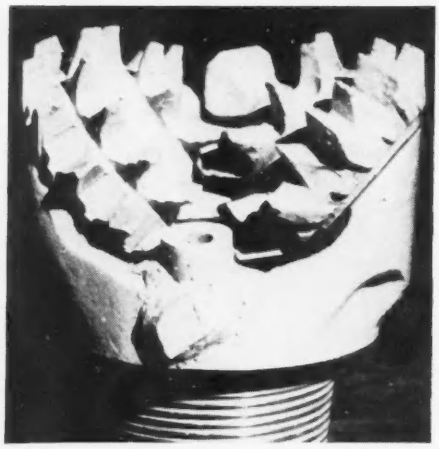

FIGURE 4. Bit "A," jet rock bit with two cutting elements.

Mississippi, the two-cutting element jet bit drilled 32 percent slower at 10,000 pounds bit weight than did the conventional bit; whereas, at 20,000 pounds bit weight, the jet-type bit drilled 16.1 percent faster than did the conventional bit. In the Anahuac shale in the Danbury field and Taylor shale in the Pickton field, both comparatively soft formations, Bit "A," having high fluid-velocity nozzles directed to the bottom of the hole, drilled at greater rates of penetration under most conditions than did the conventional bit. On the first series of tests, Bit "A" drilled from 7 percent slower to 27 percent faster than the conventional bit at bit weights varying from 8000 to 30,000 pounds. Only at 8000 pounds did the drilling rate of the conventional bit exceed the drilling rate of the bit equipped with high fluid-velocity nozzles. On a second series of tests, the rate of penetration of the jet bit exceeded the rate of penetration of the conventional bit from 69 to 122 percent at bit weights varying from 8000 to 30,000 pounds. The lower percentage was at the lowest bit weight, indicating that directing high-velocity fluid to the bottom of the hole increases the efficiency of the bit at conditions producing higher rates of penetration.

Bit "B," illustrated in Figure 5, is a two-cutting element rock bit similar to Bit "A," except for tooth design and cutting element diameter, and was made for research purposes only. On competitive tests, the penetration rates of Bit "B" were consistently less than those obtained with Bit "A," which had the high fluid-velocity nozzles directed to the bottom of the hole, and were comparable only to the drilling rates of the conventional design of Bit "A."

Bit "C," illustrated in Figure 6, is a

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GEORGE E. CANNON was born March 8, 1898, and was graduated from Austin College in 1929 with B.S. and M.A. degrees. He has since been employed by Humble Oil & Refining Company in the Production and Research departments. His present position with the company is senior supervisory petroleum engineer.

W. J. BIELSTEIN was born in Houston in 1917 and was graduated from Texas A and M College with a B.S. in petroleum engineering. He joined Humble in 1938, was in the Gas department until 1939, and transferred to the Production department. In January, 1941, he entered the Engineering division. After war service he rejoined Humble.

W. J. Bielstein

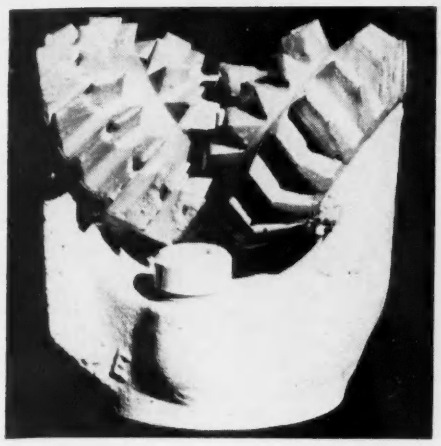

FIGURE 5. Bit "B," jet rock bit with two cutting elements.

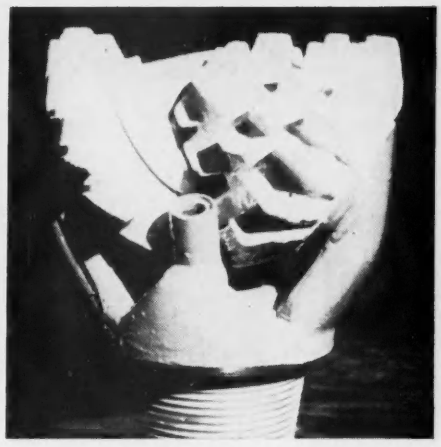

FIGURE 6. Bit "C," jet rock bit with two cutting elements.

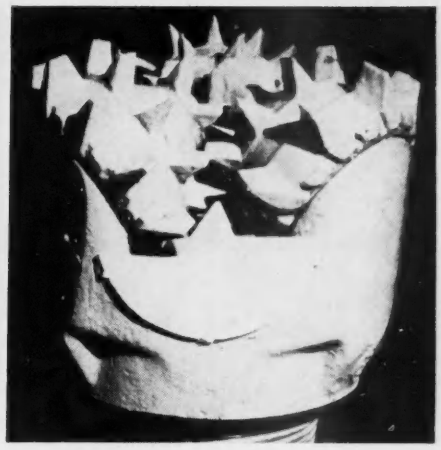

FIGURE 7. Shrouded rock bit with three cutting elements.

two-cutting element rock bit having an off-center bridge and high fluid-velocity nozzles between the bit-cutting elements directed to the bottom of the hole. This is the initial design for this type of bit, and on controlled tests in soft formations, the penetration rates obtained with Bit "C" were far below those obtained with Bit "A." At bit weights from 8000 to 24,000 pounds, the drilling rate of Bit "C" varied from 58 percent to 73 percent less than the drilling rate of Bit "A."

Three-Cutting Element Rock Bits: Rock bits having three cutting elements have been modified principally from the standpoint of changing the fluid direction and characteristics at the bit. Bits having conventional tooth designs have been changed by use of shrouds or baffles welded between the legs for the purpose of forcing all the fluid through the teeth of the cutting element and by directing the fluid through high fluid-velocity nozzles between the bit legs to the bottom of the hole.

The shrouded rock bit, as shown in Figure 7, is essentially a three-cutting element rock bit having baffles welded between the bit legs to direct all of the fluid between the teeth on the cutting elements and to the bottom of the hole. The results of controlled tests conducted on the shrouded rock bit are presented in Figure 11. At 10,000 pounds bit weight, the rate of penetration of the shrouded bit was 8 percent less than the conventional bit; however, at 20,000 pounds bit weight, the shrouded bit drilled 43 percent faster than did the conventional bit, and at 30,000 pounds 16 percent faster. Apparently forcing the fluid through the teeth of the rock bit to the bottom of the hole improved the drilling characteristics of the bit, especially as conditions producing higher rates of penetration were employed.

High fluid-velocity nozzles directed to the bottom of the hole were incorporated into the conventional three-cutting element bit design by use of an adaptor sub, as shown in Figure 8, and in some of the larger sizes by extending tubes from within the bit body out the side between the bit legs to near bottom. This latter design proved to be unsatisfactory because of fluid cutting out the tubes. Two designs of jet adaptor subs were used in adapting the high fluid-velocity nozzles directed to the bottom of the hole on conventional three-cutting element rock bits. One design, as shown in Figure 9, had a passage for the return of mud through the center of the bit and out the side of the sub. The other design did not have the mud-return passage. A modification of the first design, Figure 10, provided for field installation of bits on the subs; however, this proved to be unsatisfactory because of failures of the O-ring packing between the nozzle adaptor sleeve and bit sub.

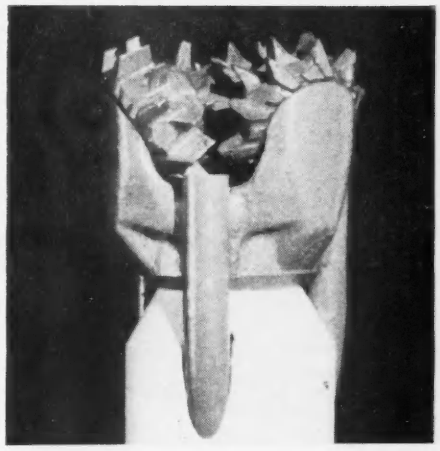

FIGURE 8. Jet rock bit with three cutting elements and jet adaptor sub.

Data on controlled tests of three-cutting element bits are presented in Figures 11, 12, and 14. As may be noted, the three-cutting element bit equipped with the jet adaptor sub and high fluid-velocity nozzles consistently drilled at higher rates of penetration than did the conventional three-cutting element rock bit. On the first of two series of tests in medium-hard formations, the three-cutting element jet rock bit drilled 118 percent, 68 percent, and 96 percent faster than did the conventional bit at 10,000, 20,000, and 30,000 pounds bit weight, respectively. On the second series of tests, the three-cutting element jet rock bit drilled at 18 percent, 38 percent, and 4 percent faster rates than did the conventional bit at 10,000, 20,000, and 30,000 pounds bit weight, respectively. Tests run in conjunction with the latter tests, using a jet adaptor sub with a mud-return passage, resulted in the jet rock bit's drilling 190 percent faster than the conventional rock bit using 20,000 pounds bit weight. The results of this test indicated that the mud-return passage in the jet adaptor sub affected the rate of penetration; however, later tests proved that little, if any, increase in penetration rate was effected by using the mud-return passage in the jet adaptor sub.

In soft formations, the three-cutting element jet rock bit drilled 7 percent, 37 percent, and 30 percent faster than the three-cutting element conventional rock bit at 5000, 10,000, and 20,000 pounds bit weight.

As may be noted from the graphical presentations, the rock bits having two and three cutting elements consistently drilled at higher rates of penetration than did the conventional bits of the same design. In addition, the rates of penetration obtained with two-cutting element rock bits were equal to or higher than those obtained with three-cutting element jet rock bits in soft formations. In medium-hard formations this trend

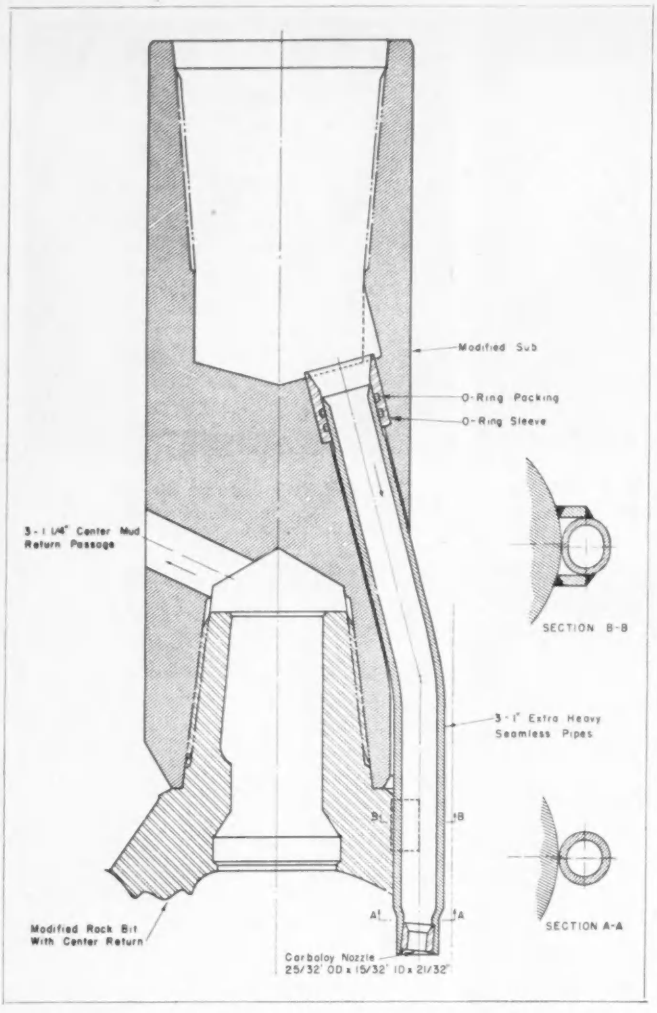
Modified Sub
O-Ring Packing
O-Ring Sleeve
3 - 1 1/4" Center Mud Return Passage
SECTION B-B
3 - 1" Extra Heavy Seamless Pipes
SECTION A-A
Modified Rock Bit With Center Return
Carboloy Nozzle 25/32" OD x 15/32" ID x 21/32"

FIGURE 9. Sub to adapt high-nozzle fluid velocity and center-mud-return passage to conventional rock bit.

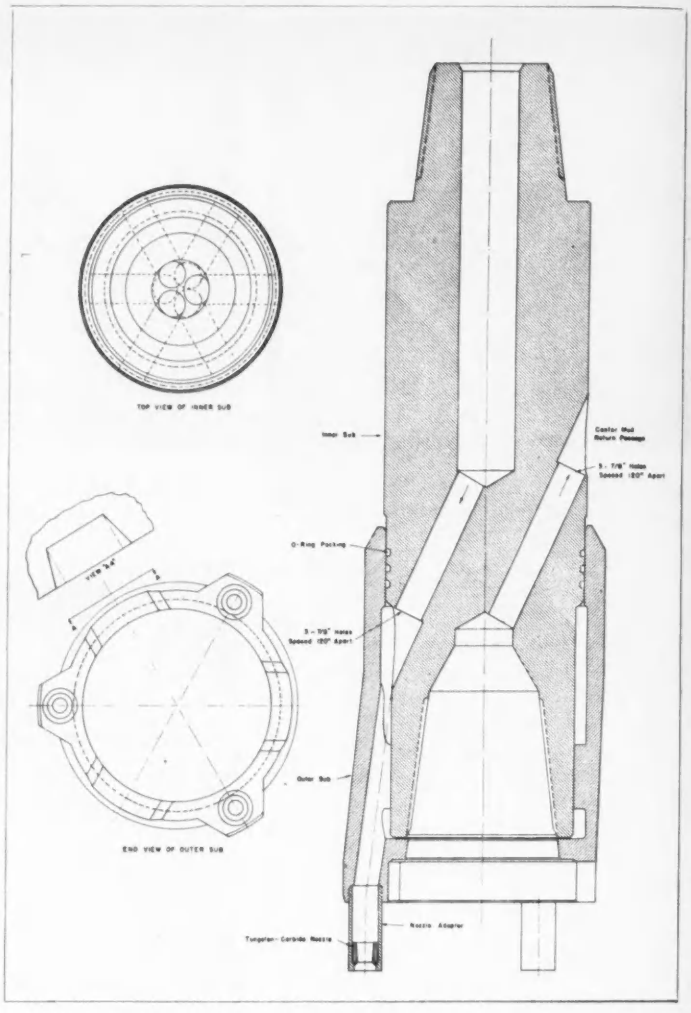

FIGURE 10. Sleeve to adapt high-nozzle-fluid velocity and center-mud passage to conventional rock bit.

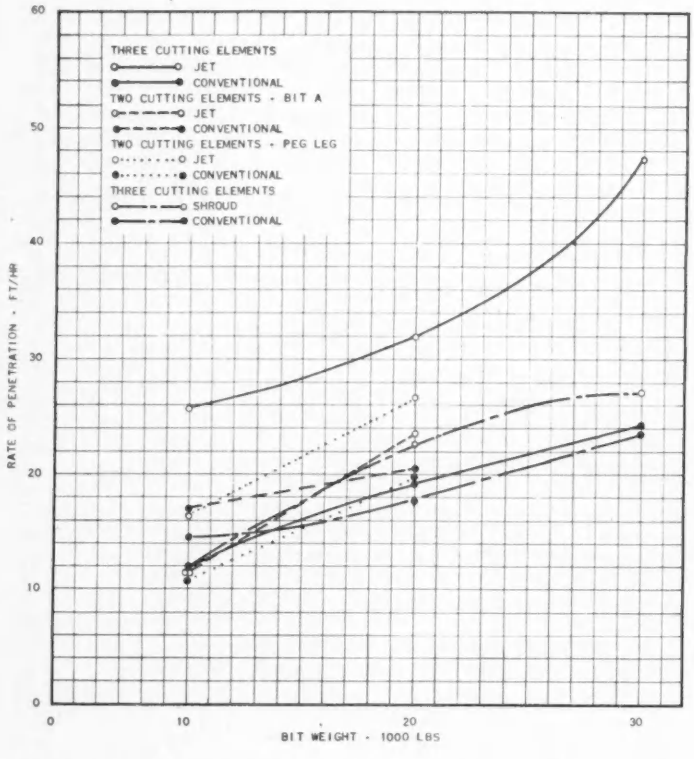

FIGURE 11. Relation of bit design and fluid distribution to rate of penetration in medium hard formation at various bit weights and constant rotary speed, Mallalieu field, Mississippi.

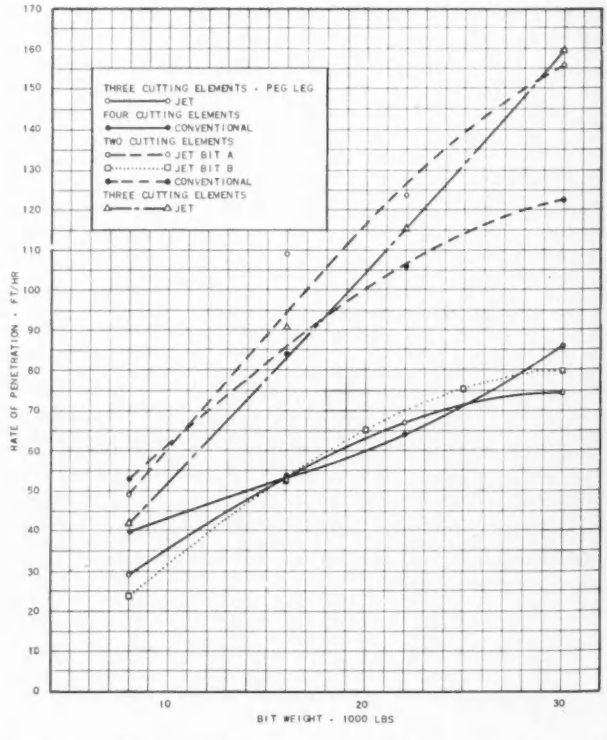

FIGURE 12. Relation of bit design and fluid distribution to rate of penetration in soft formation at various bit weights and constant rotary speed, Pickton field, Texas.

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U-34D

Double Drum Drilling Unit

SHALLOW WELL DRILLING (4,500 ft.)
DEEP WELL SERVICING (8,000 ft.)

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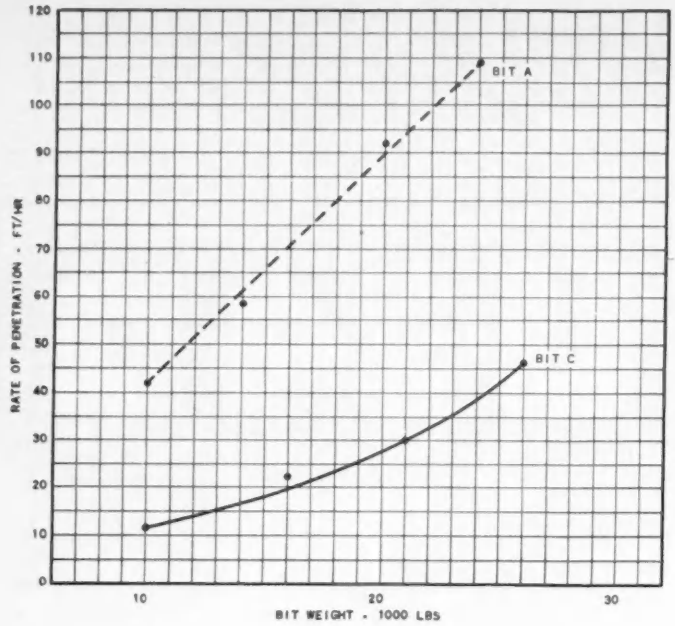

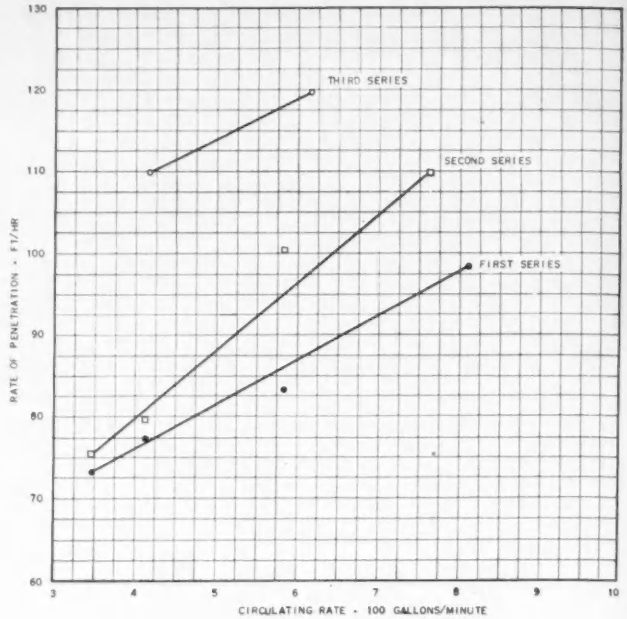

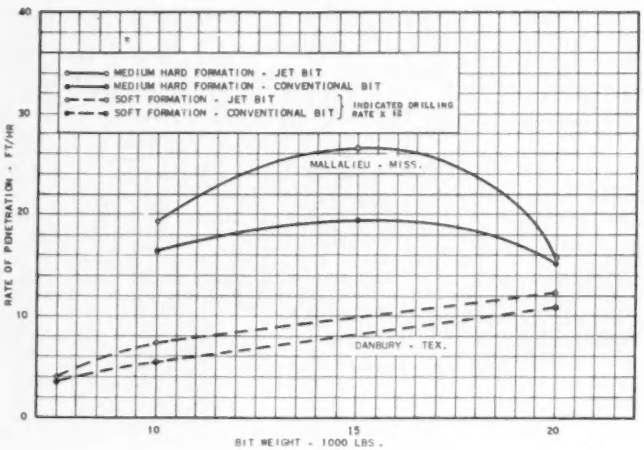
MEDIUM HARD FORMATION - JET BIT
MEDIUM HARD FORMATION - CONVENTIONAL BIT
SOFT FORMATION - JET BIT
SOFT FORMATION - CONVENTIONAL BIT
INDICATED DRILLING RATE X 10
MALLALIEU - MISS.
DANBURY - TEX.
RATE OF PENETRATION - FT/HR
BIT WEIGHT - 1000 LBS.

FIGURE 13 (top left). Relation of bit design to rate of penetration in soft formations at various bit weights and constant rotary speed, Danbury field, Texas.

FIGURE 14 (lower left). Relation of fluid distribution to rate of penetration of rock bits having three cutting elements at various bit weights and constant rotary speed in soft and medium hard formations.

FIGURE 15 (top right). Relation of circulating rate to rate of penetration using two cutting element jet rock bits at constant rotary speed, bit weight and nozzle fluid velocity.

was reversed, as the two-cutting element jet rock bit failed to equal the three-cutting element jet rock bit. These two trends were later substantiated while investigating the hydraulic factors affecting the rate of penetration of rock bits.

The controlled tests on special bits, such as the peg-leg rock bits, with and without high fluid-velocity nozzles, revealed that each cutting element should be serviced by a nozzle when using the high fluid-velocity nozzles directed to the bottom of the hole. In addition, the tooth design on the cutting elements is a major factor in the final analysis of the factors affecting the rate of penetration of rock bits.

On the basis of the above controlled tests and because the two-cutting element rock bits provided the most practicable design for incorporating high fluid-velocity nozzles directed to the bottom of the hole, the investigation of the major factors affecting the rate of penetration has been confined to two-cutting element jet rock bits in soft and medium-hard formations.

Circulating Rate: Typical test results for soft-formation drilling are presented in Figure 15. In drilling the Taylor shale between the depths of 3000 and 3700 feet in the East Texas area, the general trend established was that the drilling rate increased as the circulating rate increased. On the first series of tests, the drilling rate increased 25 percent, with a 132 percent increase in circulation rate, and a 350 percent increase in hydraulic horsepower. On the second series of tests, the drilling rate was increased 46 percent by increasing the circulation rate 120 percent and the hydraulic horsepower 296 percent. A third series of tests run in soft formations resulted in an 8 percent increase in drilling rate for a 49 percent increase in circulation rate and a 181 percent increase in hydraulic horsepower.

The general trend established for the effect of circulation rate on rate of penetration is that an increase in drilling rate accompanies each increase in circulating rate; however, the rate of change of this variation has not been established. It is apparent that the increase in penetration rate to be expected by increasing the circulation rate is small as compared to the increase in hydraulic horsepower required to effect the change.

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[2] "Results Obtained with High-Fluid-Velocity Rotary Bits," by J. P. Nolley, G. E. Cannon, and Douglas Ragland.

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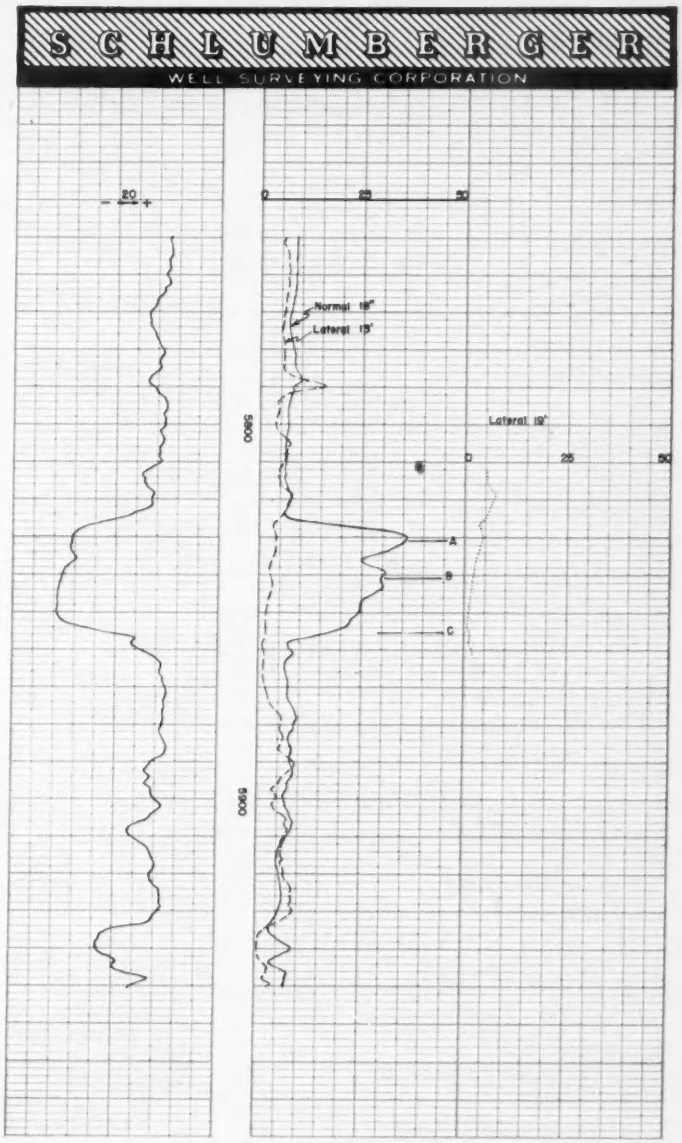
[5] "Hard Rock Rotary Drilling," by F. L. Scott, American Association of Oilwell Drilling Contractors, San Antonio, Texas, October 1-2, 1946. Also, The Oil Weekly, Vol. 123, No. 6, p. 17, 1946 (Oct. 7).

STRAWN SAND IN SIVELS BEND FIELD COOKE COUNTY, TEXAS

Mud (Magcogel & Water)
$R_m = 0.9$ ohm at BHT
Bit Size: 8¾"
Spacings: AM = 18"
AO = 13' & 19'



LOG ANALYSIS

1) Water saturation S

At Level A $R_o = 1$
$R_t = 4$

$$S = \sqrt{\frac{1}{4}} = \sqrt{.25} = 50\%$$

At Level B $R_o = 1$
$R_t = 2.5$

$$S = \sqrt{\frac{1}{2.5}} = \sqrt{.4} = 63\%$$

At Level C $R_o = 1$
$R_t = 1$

$$S = \sqrt{\frac{1}{1}} = 100\%$$

2) Formation water resistivity R_w

$$SP = -70 \log_{10} \frac{R_m}{R_w} \text{ and } SP = -100 \text{ mv.}$$

$$\frac{R_m}{R_w} = 27$$

$$R_w = \frac{0.9}{27} = 0.035 \text{ at BHT}$$

3) Porosity p

$$F = \frac{R_o}{R_w} = \frac{1}{.035} = 28$$

$$p = \sqrt[m]{\frac{1}{F}} = \sqrt[m]{\frac{1}{28}} = 19\% \quad \text{for } m = 2$$

CORE ANALYSIS

Average Porosity 22%
Average Permeability 81.5 md

DRILL STEM TEST

5824' - 5834' (1560' Oil and 60' Brackish Water)
5834' - 5848' (2070' Fluid, 97% Water, 3% Oil)
Water level found to be at 5841'

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HOUSTON, TEXAS

Sand Consolidation With Resins

By WAYNE F. HOWER

Halliburton Oil Well Cementing Company, Duncan, Okla.

THE AUTHOR DESCRIBES a method for selectively impregnating sands of varying permeability so as to obtain a uniform sheath of resin-cemented grains as a shield against sanding up of a well. The method has been rigorously laboratory tested.

SAND trouble — the gnawing cancer of the oil industry — has caused decreased production and short life for many an oil well. In many oil-producing formations, nature has provided an excellent bonding material to hold the sand grains together and thus permit the efficient production of oil. In others, where nature's "bonding" was either poorly done or not done at all, sand is produced with the oil. Even if a natural cementitious material is present, but not adequate, its eventual dissolution by water results in sanding troubles.

A sanding well presents numerous problems. Quite often the flow of oil is stopped completely, while in other cases, floating sand will cut out integral parts of the production equipment. Rig time, replacement of parts, and loss in oil production are the costly results of these sand troubles.

In an effort to remedy this condition, production men have tried gravel packing and various types of metal screens. The use of a new type of screen, called the permeable plastic liner, is meeting with success.

Still another method, the sand plastic process, has been made available in recent years. It uses liquid resins that set and bind the sand grains of the formation together to prohibit their movement, but still permit the passage of well fluids to the surface.

There are many problems in finding suitable resins to consolidate loose sands in oil wells. It requires a resin, or mixture of resins, that can be forced into a sand formation to give a hard but permeable consolidation. These mixtures must remain fluid and pumpable long enough to be properly placed. They cannot be exorbitant in price. They must be applicable through the wide temperature ranges of 60° F to 230° F or higher. Finally, the set resin must be insoluble in the oils and brines normally expected in a well.

It was necessary to test many kinds of resins before a type was found that would meet the above requirements. The class of resin chosen was in the phenolic thermosetting group and two distinct resins were obtained that proved suitable for this purpose.

Treating an oil-bearing formation with a synthetic resin consists in actually building a screen around the casing that will be stable and not let any of the unconsolidated sand come through the perforations. One might say that the well is naturally "gravel packed" with exactly the correct size of gravel and the only detail left to man is to add the cementitious material to the pack.

FIGURE 1. Distribution of consolidating resin in zones of different permeability using no control penetrant.

Resin should be made to permeate the sand body uniformly and not allowed to flow into channels of least resistance. In a well that has been sanding for a period of time, the sand has become loosely packed around the perforated casing. In such a case, it is well to take preliminary measures to close any bypasses present or that might be formed by the resin-fluid movement.

Resin-cement is a mixture of a liquid resin and cement that can be pumped and squeezed into a formation in much the same manner as cement. Part of the fluid phase, which is resin, is lost to the formation and sets hard to form a very efficient block adjacent to the cement-sand interface. The treated section can then be gun-perforated and the well is ready to treat.

There are other factors that must be considered before treating a well with resin to consolidate the sand. It is not possible to obtain a permeable consolidation with every type of formation. Lenticular formations, made up of thin streaks of shale and sand, are especially difficult to treat in that the resin consolidates the sand but not the shale. The shale breaks down and weakens the consolidated sand, finally allowing the well to sand again. Other sands are contaminated with fine silt and montmorillonite.

The process depends on the fact that an unconsolidated sand body has a fairly large permeability and porosity. If enough individual particles in the formation are so small that there is little interstitial volume, the resin, in coating

each particle, will fill these spaces and not leave any permeability. Then small particles also have a tendency to be pushed ahead of the resin, bridging and blocking flow of the fluid. Proper displacement cannot be obtained and the formation will be plugged.

A very unusual case has been encountered in one area where a permeable consolidation was obtained. Production of oil stopped in a very short time but fluids could be pumped back into the formation. It was found that silt and mica had packed around the extremities of the consolidation to prevent the flow of fluids to the well bore. This points out the fallacy of using certain acids to clean silty sand adjacent to the formation as the undissolved silt not treated with the acid can still move up and plug the consolidation.

The quality of crude in the various pools will vary greatly. To clean the sand of this crude, a predetermined amount of diesel fuel is pumped into the formation before treating the well with resin. This oil is very efficient in cleaning the sand grains so that it is possible to obtain good contact with the resin.

Since oil wells are drilled to different depths, a wide range in formation temperatures may be expected. The low temperatures (60° to 150° F) require a certain mixture of resins, while other formulas cover the range to 230° F. For this reason, it is necessary to obtain an accurate bottom-hole temperature before selecting a formula and mixing the resins. The setting of resin mixtures is controlled by combining various resins with an accelerator for low temperatures and by the use of a slow-acting resin with an accelerator for high temperatures. The initial set, or gel stage, of a mixture governs the pumping time available for placement. Then comes a gradual hardening to sufficient strength, which is known as the set time.

When the resin mixture sets, it shrinks around the sand grains, but only a limited amount of permeability is obtained by this shrinkage. To make certain that as much permeability is retained as possible, diesel fuel is pumped through the unset resin in the formation. The diesel fuel is not miscible with the resin mixture but acts as a flushing agent to force the resin mixture from the interstices and still leave an envelope of resin about each sand grain.

FIGURE 2. Distribution of consolidating resin in zones of different permeability using the control penetrant. Compare the resin distribution with Figure 1.

After the resin has set hard, usually a period of 24 to 36 hours, depending on the formation temperature, the well is brought back on production by conventional methods.

There is another material employed to assist even distribution of the resin in all parts of the formation. Since the permeability will vary greatly at different points, it is logical to believe that most of the resin will enter the more permeable zones of the structure, and that only a partial consolidation will be obtained. This uneven distribution of the resin is illustrated in Figure 1. The liquid resin was forced into loose sands having a wide range of permeabilities and allowed to set. The unconsolidated sand was washed away and the exact amount of penetration noted by the amount of consolidation in each zone. As was expected, the coarse sand had taken most of the resin.

To equalize this flow of fluid, a control penetrant is added to the resin mixture, causing nearly equal amounts of resin to enter all parts of the formation regardless of varied permeability. Figure 2 illustrates the effect of this control penetrant.

This material, an inert powder, is filtered out of the resin mixture as it enters the zones of high permeability and forms a filter cake on the face of the sand. This cake produces a resistance to flow accompanied by a noticeable increase in pumping pressure. This automatically causes fluid to be forced into the zones of successively lower permeability.

This filter cake is removed by the diesel fuel used to displace the resin mixture and thus does not leave a permanent block that would prevent the flow of oil into the well bore.

The amount of resin to be used depends primarily on the number of feet of formation to be treated, and its porosity. Experience has shown that it requires 15 to 30 gallons of resin per foot to be successful. This range in volume generally takes care of the various well conditions and will give enough penetration to consolidate a sufficient thickness of formation to control the sand.

The amount of diesel fuel used to clean the formation ahead of the resin depends on the number of feet being treated and on the API gravity of oil being produced. In general, one-half barrel to two barrels per foot is used for this purpose. The amount of diesel fuel for the final displacement depends entirely on the amount of resin used in the treatment, and two to four times the volume of resin is a satisfactory amount. Enough diesel fuel is pumped to thoroughly open the pore spaces between the sand grains. If more than the above amount is used, no deleterious effects will be noted as enough resin is always left clinging to the sand grains.

The method of sand plastic application is described below. For example, the following well data are used:

Total depth.....4010 feet
Casing .....5.5 inches
Tubing .....4000 feet, 2 inches
Zone perforated.....4000-4005 feet
Perforations per foot..... 4
Formation temperature .....145° F

With five feet of sand to be treated,

TABLE 1

	Sand A Percent	Sand B Percent
On 20 mesh screen	0.00	0.00
Through 20 mesh screen on 40 mesh screen	0.04	0.09
Through 40 mesh screen on 60 mesh screen	0.16	1.50
Through 60 mesh screen on 100 mesh screen	28.34	63.18
Through 100 mesh screen on 200 mesh screen	66.24	33.95
Through 200 mesh screen on 325 mesh screen	4.35	1.06
Through 325 mesh screen	0.87	0.22

it calls for 120 gallons of the resin mixture and 15 pounds of the control penetrant powder. Cleaning the sand requires eight barrels of diesel fuel ahead of the resin and 12 barrels behind for displacement. Tubing capacity is 15.5 barrels. This displacement volume is always needed in order to properly displace the resin out into the formation.

A retrievable cementing tool is placed on the end of the tubing to prevent the flow of fluids between the tubing and casing.

The well bore is cleaned of all sand and other foreign matter and the tool and tubing run into the hole. Pump pressure is applied and the formation is tested to see if the formation will take fluid. Pressure is released, the circulating valve opened and eight barrels of diesel fuel are pumped into the tubing. Then comes the proper mixture of resins followed by 4.5 barrels of diesel fuel. This amount of fluids fills the tubing and the circulating valve is immediately closed. The remaining diesel fuel, followed by crude or mud, is then pumped into the tubing and the first diesel fuel cleans the sand as it is being forced into the formation. Displacement is continued and, as the resin starts to enter the formation, the pumping pressure will increase due to the building of a filter cake with the control penetrant. Pumping, at this point, is decreased to the rate of one-half to one barrel per minute and kept so for the remainder of the displacement. As the diesel fuel used in the final displacement starts to enter the formation, the pumping pressure gradually decreases. After 14.5 barrels of crude or mud have been pumped, displacement is stopped, leaving one barrel of diesel fuel in the tubing.

The well is left in a static condition for 24 hours and the tool removed. The well is brought back on production by conventional methods.

In some cases, a well requires a second or third batch of resin. This is expected where formations are extremely weak or permeable.

Making Sand

The treated well often makes a little sand while cleaning up. Just how much sand, and for how long, will vary for each well. Some have made sand persistently for as long as several weeks after a treatment. This can be caused by a perforation being plugged with mud or shale and no resin entering that part of the formation. This emphasizes the need of thoroughly cleaning the well bore before treatment.

The expanse of formation that can be treated at one time will vary for the type under consideration. Experience has shown that up to 30 feet in thickness is suitable, but a successful treatment of a formation 61 feet thick has been accomplished. On very thick sections, it is best that the resin be applied in stages to convenient-sized sections. Use of the control penetrant is especially important when treating thick sections.

No general statement can be made as to the percentage reduction of permeability of a formation when it is treated. If the sand is completely unconsolidated around the casing, the size, shape, angularity and distribution of the sand grains greatly influence the permeability of a resin treated formation.

Some work has been done in an effort to determine accurately the percentage reduction of the permeability of an unconsolidated sand after it has been treated with resin. Figure 3 is a drawing of the equipment used for these determinations. The sand was packed in the Lucite container by tapping the sides of the tube. This step was done as carefully as possible, and it is believed that there was no segregation of the various-sized sand grains during this process. The sand was not tamped as the amount of packing, and thus the permeability would vary in different parts of the column. Wire screens and spun glass were used to prevent the sand from entering the inlet, outlet, and the pressure taps P_1 and P_2.

The air permeability was determined by passing air at a constant rate through the sand body and measuring the pressure at P_1 and P_2 on the manometer. A metering device determined the volume of air passing through the sand body and also provided a resistance to the flow of air so that the values obtained at P_2 were appreciable. Values obtained at P_1 were naturally raised by the same value. The permeability was determined by the following well known formula.

$$K = \frac{Z\,\overline{Q}\,L}{A(P_1 - P_2)}$$

Where

- K = Permeability in Darcies
- Z = Viscosity of the medium passing through the sand body in centipoises
- $\overline{Q}$ = Average flow in cc per second at mean pressure within the sand body
- L = Length of sand body in centimeters under investigation (P_1 to P_2) incentimeters
- A = Areat of sand body under investigation in square centimeters
- P_1 = Pressure, in atmospheres, at P_1
- P_2 = Pressure, in atmospheres, at P_2

When determining the permeability of the sand body to water or oil, the following procedure was used:

To obtain the pressure at P_1, valves B and D were opened and valves C and E were closed. The fluid in the system entered the Lucite connection at P_1 and flowed into the capillary. When it reached point A (level mark), air pressure was applied through valve D that held the

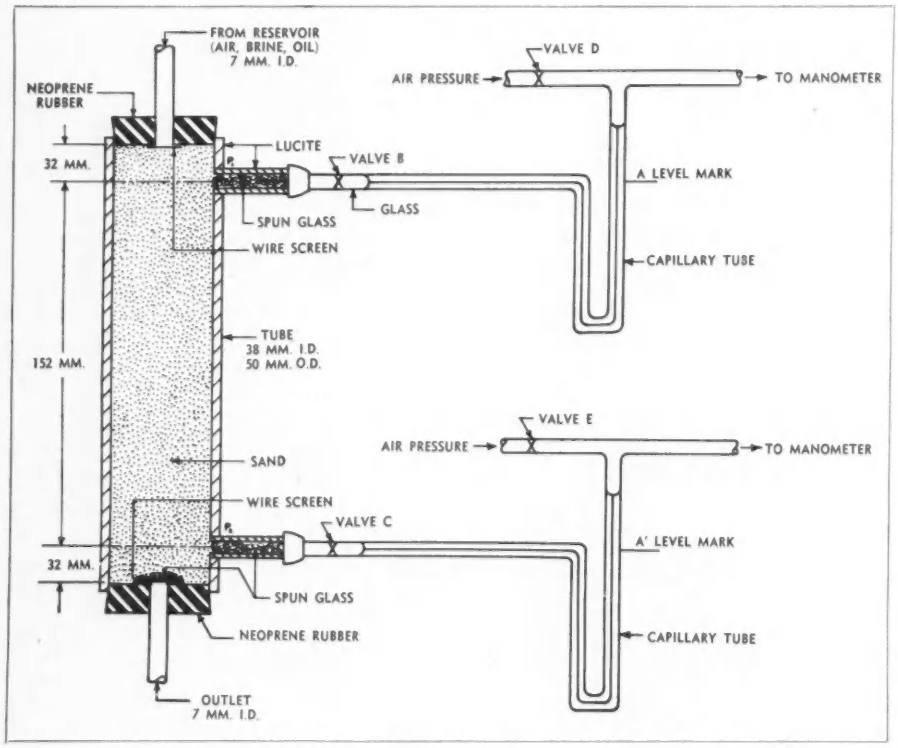

FIGURE 3. Sketch of apparatus used to determine the permeability of a sand body before and after being treated with resin.

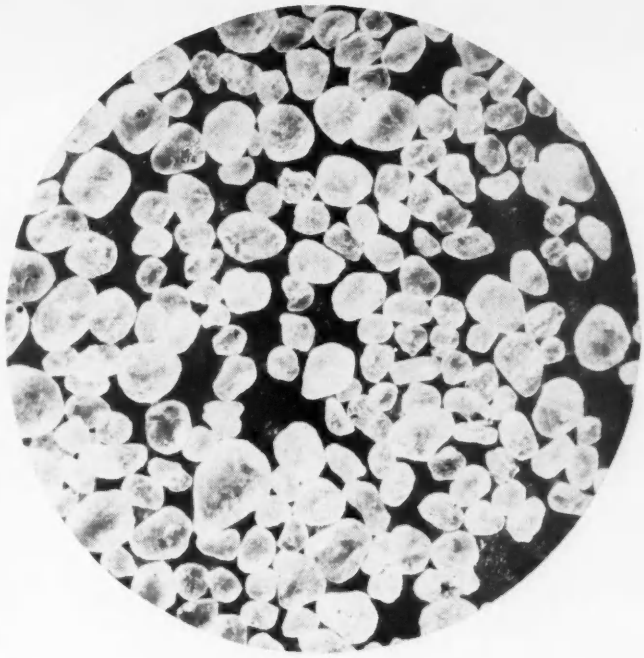

FIGURE 4. Photomacrograph of round and smooth edged sand grains. Magnification 14X.

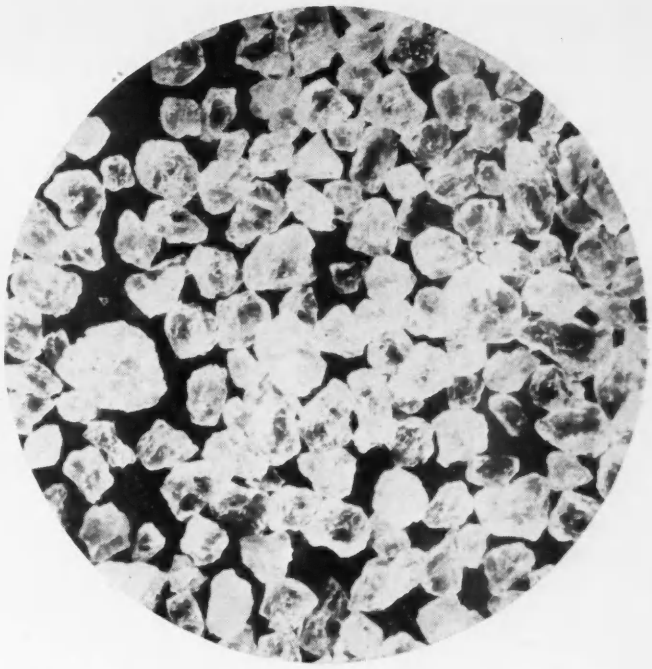

FIGURE 5. Photomacrograph of angular and sharp edged sand grains Magnification 14X.

fluid at this mark. The pressure exerted at point P_1 was then read on the manometer.

To obtain the pressure at P_2, valves B and D were closed and valves C and E were opened. The fluid was adjusted at A' (level mark) with air pressure as above and the pressure at P_2 read on the manometer.

Sands having the screen analysis shown in Table 1 were used in these experiments.

Sand A has a porosity of 35.52 percent and its shape is such that there are no sharp edges on the grains. This round type of sand is shown in Figure 4.

Sand B has a porosity of 37.03 percent and is an angular sand with no round edges. This angular type of sand is shown in Figure 5.

Various oil well brines and crude oils were used in the permeability determinations. Brine A has a viscosity of 0.999 centipoise, a total solids of 56,700 parts per million and a specific gravity of 1.038. Brine B has a viscosity of 1.345 centipoises, a total solids of 204,200 parts per million and a specific gravity of 1.129. Crude oil A has a viscosity of 18.3 centipoises and an API gravity of 29.8 degrees. Crude oil B has a viscosity of 12.32 centipoise and an API gravity of 32.3 degrees.

The general procedure for the permeability determinations is as follows: All tests were made at 78° F. The air permeability of the sand column was determined and then the sand was saturated with a brine. The brine permeability was determined and the brine displaced with crude. The displaced brine was accurately measured and the crude oil permeability determined. The sand column was then treated with 120 cc of diesel fuel, 30 cc of consolidating resin, and 120 cc of diesel fuel. After the 24-hour setting period, the crude oil permeability was again determined. The brines and crude oils were used in different combinations to give a total of 4 determinations for each sand.

Extreme care was observed in filtering the brines and oils as a very small amount of undissolved solids will prevent accurate determinations.

Results of tests with Sand A are shown in Table 2.

The most important percentage of permeability retention is the oil-to-resin value and it averages to be 35.6 percent. Therefore, we would expect a reduction of permeability of a tightly packed sand of approximately 65 percent. This value may seem to be large, but it should be pointed out that over 2000 millidarcys of permeability are retained, which is much greater than the permeability of the average formation.

The values given in the above tables are for more than one determination for each combination of brine and crude oil. Results could be duplicated very closely with this round sand and the use of different brines and oils seemed to have no real effect on the resulting permeability.

Results of tests with Sand B:

Penetration of resin in the sand column — 11.67 cm. (Average)

Brine necessary to saturate sand column — 90.9 cc (Average)

Brine recovered — 79.4 cc (Average)

TABLE 2

PERMEABILITY DETERMINATIONS				PERCENT PERMEABILITY RETAINED		
Air Md.	Brine & Type Md.	Oil & Type Md.	Oil After Brine-Md.	Air to Resin	Brine to Oil	Oil to Resin
7947	7915-Brine A	6265-Crude A	2275	28.6	79.2	36.3
8500	8520-Brine B	6610-Crude A	2422	28.5	77.7	36.7
7462	7445-Brine B	6615-Crude B	2375	31.8	89.0	35.9
7280	7320-Brine A	6030-Crude B	2010	27.6	82.5	33.4

Penetration of resin in the sand column	14.2 cm
Brine necessary to saturate sand column	87.1 cc
Brine recovered	78.0 cc
Brine left in sand column as connate water	9.1 cc
Porosity of sand column as determined from brine necessary to saturate	35.55 percent
This porosity checks very closely to the porosity of the sand as determined previously to be	35.52 percent

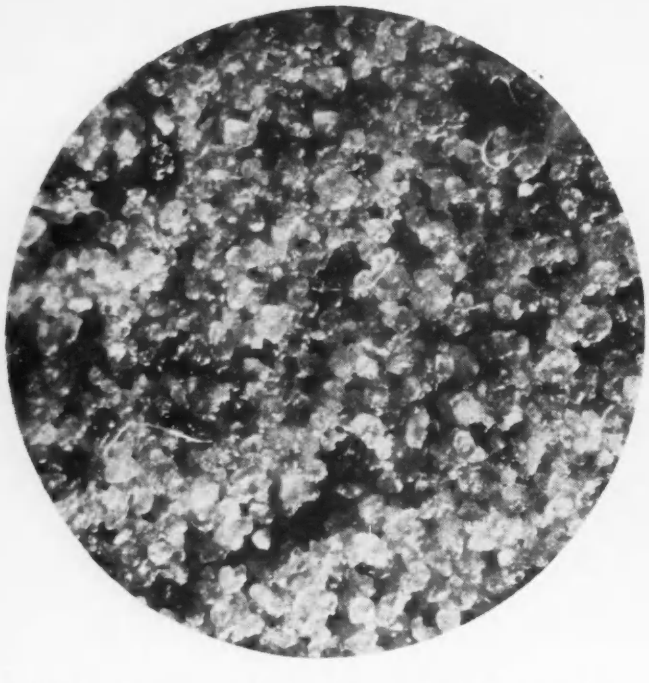

FIGURE 6. Photomacrograph of sand consolidated with resin. Permeability 2675 millidarcys. Magnification 14X.

FIGURE 7. Photomacrograph of sand consolidated with resin. Permeability 720 millidarcys. Magnification 14X.

Brine left in sand column as connate water — 11.5 cc (Average)

Porosity of sand column as determined from brine necessary to saturate — 37.08 percent (Average)

This porosity checks very closely to the porosity of the sand as determined previously to be 37.03 percent.

Considerable difficulty was encountered in packing sand B in the Lucite tube to get consistent results. Air permeabilities varied from 11,200 millidarcys to 16,220 millidarcys and the oil permeabilities after resin treatment varied from 1413 millidarcys to 3810 millidarcys. It was noticed that sand B decreased in volume much more than sand A when it was packed in the Lucite tube. This, and the inconsistent results noted above are undoubtedly due to the sharp-angular sand grains. Their shape makes it possible for the individual grains to wedge themselves together in many different ways and thus give the wide range of permeabilities. Sand B has an average grain size that is larger than sand A and should give greater permeabilities. This is seen to be true for the air determinations. An average of many determinations has been taken and are recorded below.

Air Permeability .....13,116 Md
Brine Permeability .....11,353 Md
Oil Permeability .....11,854 Md
Oil Permeability after resin treatment ..... 2,275 Md

The percentage of permeability retained from the oil permeability is 19.2 percent and is much less than that retained for the smooth grains in sand A. The consolidation for sand B is stronger than the consolidation for sand A and supports the packing and wedging theory of the sand grains. It can also be noticed the column of sand B did not have as much resin penetration as in sand A.

The above results show the importance of the shape of the sand grains as well as the size of the sand grains in resin consolidation work as far as the expected permeability is concerned. The percentage reduction is large but enough permeability is retained in the treated formation to produce the usual quantities of well fluids. Actual field applications have proven this point where sands relatively free of silt and shale have been treated.

Practically all of the field applications have been in wells that have had casing set through the pay zone and then gun perforated. A few successful applications have been made through worn out screens in open holes. Work in open hole has shown promise but such applications are not recommended except where the conditions are ideal. A few gas wells have been treated with this material with success.

The over-all field results that have been obtained with this process are encouraging. Wells have been treated having formation temperatures between 103° F and 225° F. Table 3 lists a few examples of the many wells that have been treated with resin.

It has been shown that this process has certain limitations in that it cannot be used to consolidate oil-bearing sand formations that contain appreciable amounts of foreign matter; but, it has been successful in treating a large number of wells and is definitely established in the oil industry as an aid to production.

TABLE 3

LOCATION	Depth, Feet	Stages	Gallons Resin	REMARKS
Bayou Perot, Louisiana	9,358	2	300	Makes no sand
Davis, Oklahoma	3,886	1	1000	Makes no sand
Black Bayou, Louisiana	5,155	1	200	Makes no sand
Weeks Island, Louisiana	13,888	2	300	Makes no sand
Hillje, Texas	5,233	1	150	*
Spanish Camp, Texas	2,902	2	300	Makes no sand
Gulf of Mexico	5,842	2	300	Makes no sand
Barataria, Louisiana	8,240	2	250	Makes no sand
Lockport, Louisiana	6,654	1	75	Makes no sand
West Lake Verret, Louisiana	6,964	2	300	Makes no sand

* Varying amounts of sand being produced. Never did clear up but well was improved. Not completely successful due to lenticular shale in pay zone.

ACKNOWLEDGMENT

The author extends appreciation to Halliburton Oil Well Cementing Company for permission to publish this paper and to the members of the Organic Laboratory, especially Mrs. Elizabeth Modrall and Warren Ostroot, for their valuable aid in the development of the process.

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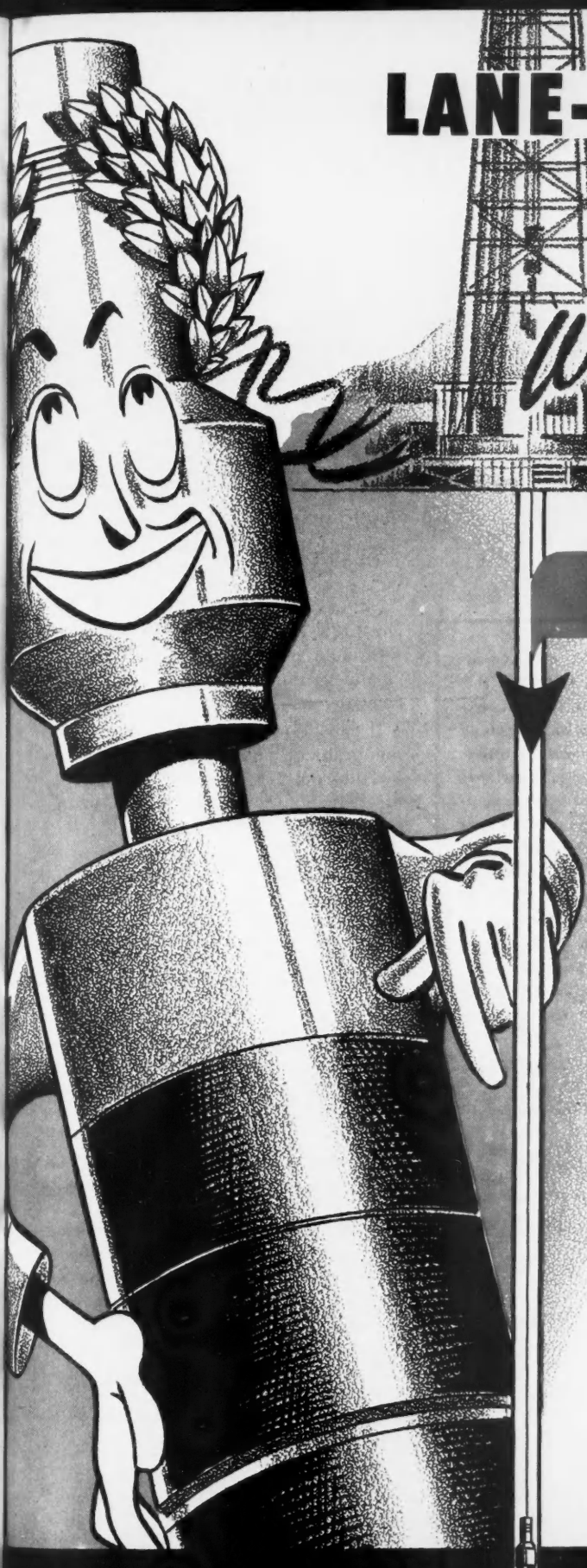

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P-305

Rig-to-Office Communication

By

C. J. PAINE
President, Paine Drilling Company

with

JERRY STOVER
Communications Consultant

IN DISCUSSING RADIO communications for the drilling industry, this paper gives numerous specific examples of advantages to be gained by direct contact between the office, or automobile and the rig. Experience has shown the use of radio communications reduces mileage on field cars and permits the contractor's trucks to get a job done quicker and with less travel, but the greatest savings is said to be in reduced shutdown time for breakdowns and repairs. This is from a paper presented before the American Association of Oilwell Drilling Contractors at Dallas, September, 1949.

THE question most often asked us regarding radio communication for the drilling industry is: "What does radio save you?"

That is a hard one to answer, and from the standpoint of dollars, probably an impossible question to answer with any great accuracy.

We do know that our mileage has dropped off on our field cars and our trucks are doing a job quicker and with less travel. We know our telephone bills are less, but with the varying activity in different localities which a drilling firm encounters, trying to put the finger on actual savings is a hard task.

There are a few accurate checks. By applying a sort of flexible formula to daywork billings to customers, it is found that they are about 30 percent less than before we started using radio. That has a double-bitted advantage. We have never been able to charge a rate for daywork, because of competitive conditions, that would allow us to break even. Therefore, the more daywork we billed, the greater the loss. On the other side of the fence, the producer was spending his dollars on daywork beyond what he now spends. With radio, both the producer and contractor are saving. How does this saving occur? In the area where we work there are several sands and limes capable of producing oil. From location to location these sands vary to the extent that almost all of the wells in the area are wildcats. Under the old system, when a sand was encountered the rig was immediately shut down until a representative of the company could be contacted. This sometimes took several hours. Now the wait is usually less than 15 minutes. When a driller gets a change in drilling time he will immediately contact the geologist or engineer in the area by radio, and then follow instructions by radio, even while the company man is on his way to the location. The same plan works on wildcats. Instead of the company having an engineer or two on the location sweating it out 24 hours a day, one man can easily and efficiently check two or three wells in an area.

Long-Distance Direction

One incident a year or so ago would have been impossible before radio. We were operating four rigs for one company in North Texas, and on this day we were down to one company representative, a smart young engineer. One rig was near Jacksboro, Texas, one near Olney, and two in the far western part of Young County. One rig was drilling in, another taking a drill-stem test, one coring, and the other running an electric log. Normally, this would have taken an engineer with a jet propelled fighter or at least seven league boots. But not with rig-to-rig radio. Parking himself in the doghouse of the rig near Jacksboro, the engineer virtually kept himself at all of the locations at once. The operations were all a success and were just as successful as they would have been had a company man been on each location.

It can be said that radio communication in the drilling industry saves dollars for the contractor and the customer by the reduction in shutdown time waiting for orders.

Probably the greatest saving is in reduced shutdown time for breakdowns and repairs. Early in our company's radio life, I was driving between Wichita Falls and Dallas late one night. Naturally, I had my radio on. I heard a driller on a rig call one of the tool pushers at his home and report that a bearing on the pump shaft was heating and seemed about ready to go out. The pusher told the driller to watch the bearing, and to shut down if it seemed to be going out. He then called our mechanic who happened to be within radio range in his pickup, discussed the trouble with him and asked him to go by the rig on his way into town. The mechanic picked up the bearing, went to the rig, replaced it that night and the shutdown time was practically nil. Had it not been for radio, the driller either would have shut down until morning or would have run the rig until the bearing failed, which would have meant a lot of down time either way. Needless to say, our shutdown time waiting for repairs has practically become nonexistant.

Radio has made another direct contribution to efficiency. In years past most pushers felt that to get a good job done they must stay on the job most of the time, day and night. There was always that constant fear in their minds that if they left something would happen. And lots of times it did, just as they drove around the corner, with the result that a rig might be shut down for several hours. This kind of thing didn't exactly

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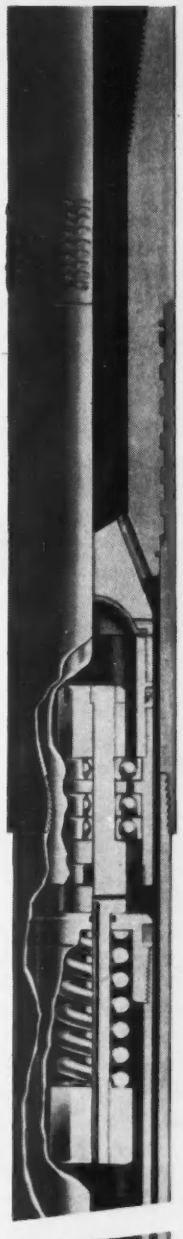

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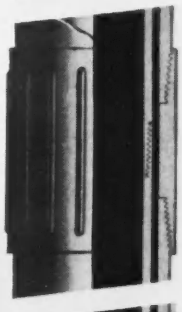

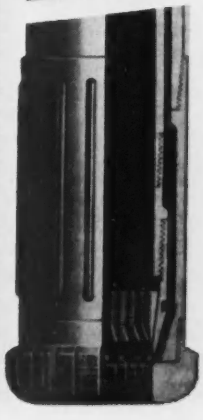

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contribute to good sleep and peace of mind and sometimes a pusher would be so worn out from lack of sleep that he didn't deliver his best in the clutches. Radio has helped eliminate this to a great extent. Since we have radio stations in all pushers' houses, a man can now go home at a reasonable hour and go to sleep knowing that if anything out of the ordinary happens he will know it within a few moments. Many times this means a trip back to the rig with supplies; more often it means that the problem can be discussed with the driller and the solution worked out without the pusher leaving his bedroom. At all times it means that a pusher can sleep without worry.

Many contractors have told me they would never put radios on rigs because they were afraid that pushers would do all their pushing from the local pool hall or the hotel lobbies. That is one fear that can be eliminated, and eliminated completely, according to our experience. Our men are getting a better job done with radio than they did before and, if anything, they are spending more time on the rigs now than they did before radio.

Here is one byproduct of radio that doesn't put money in the bank but is surely a source of satisfaction. I can remember back over the years that I would start straining my eyes from the minute I could see a rig, trying to see what was going on. If the kelly was up in the derrick, or a stand of pipe was out when I thought it should not have been, or if I could see smoke over the hills where the rig should have been, my mind started working up all kinds of dire things that must be wrong. I have probably dreamed more fishing jobs two miles from a rig than anyone in the drilling business. Now you don't wonder when you drive up. If anything is wrong, you would know it a long time before you could see the rig. If you are especially curious, pick up the mike and ask the driller.

I wonder how many miles all of us have wasted in our life trying to find someone in the field. Many times I have tailed someone all over a county, rig to rig, until I figured the guy had probably blown away. Now when we want someone in our outfit we just pick up the mike and tell him where to be.

Truck dispatching has really paid off. There are fewer empty return trips with radio equipped trucks, and when something is needed in a hurry a truck can always be found and usually that truck will be near enough to what you want that a lot of time is saved. This also means less shutdown time for the rigs.

In talking to various contractors about radio communication, I find that a lot of field men don't want it. This is true in many cases and it is hard to figure why this attitude exists. I have also talked to a lot of contractors who now have radio equipment and everyone of them tells me their field men are completely sold and they usually are after management to add additional equipment.

My best example of how our field men feel about radio happened just a few days ago. I had told them we would have to be without our equipment for two days while it was being changed over to a newly assigned frequency. Their question to me was, "But how are we going to run the rigs without radio?" And they were serious.

I think most of the opposition from field men who have not looked into radio comes from the fact that they think they are going to be burdened with a lot of knobs and gadgets and tubes that will constantly be getting out of order. Nothing could be further from the truth. Jerry Stover, who knows almost everything there is to know about oil field radio, both from the practical and the technical standpoint, will tell you a lot about how simple and trouble-free radio really is. Just a word about Jerry. He installed our equipment as his first oil field job about three years ago and since that job was the first radio installation in the contract drilling industry, he was in on the ground floor of this business with all its problems. And he has been able to whip the problems as they arise.

About the only characteristic common to all drilling rig radio systems is that they use radio! There is no such thing as a "standard package." While this is true of nearly every radio system, it is particularly true of drilling systems. Rigs are different, area of operations are never the same and, most important, each drilling contractor has his own idea as to how he wants to use radio.

Fortunately, radio is an extremely flexible tool and can be adapted to almost any type of operation. However, to get the most out of any radio system it must be properly engineered.

To do this, even with the assistance of a radio engineer, the contractor should know what the various elements of a system are, what they will do, what they won't do and how much each costs.

Elements of a Two-Way System

A two-way radio system for drilling operations is usually a combination of three basic elements:

1. The mobile unit in cars and trucks.
2. The portable unit on drilling rigs.
3. The office station, which can be at a toolpusher's house or in an office.

The mobile unit consists of a transmitter and receiver which are usually mounted in the trunk of passenger cars and in tool boxes on trucks. The output of the transmitter is usually 30 to 60 watts. (It may be interesting to note that the output of some broadcasting stations is 50,000 watts.) The antenna is a steel whip and spring. It can be mounted either on the roof or side of the vehicle. The standby battery drain of the mobile unit is only slightly greater than that of a normal car radio—about nine amperes. The heavy current drain is only during the transmitting time.

For this reason, heavy duty batteries and slow speed generators are required only if the car does a great deal of city driving where the normal generator does not turn up enough to build the batteries up.

The calls to a mobile unit are received over a small metal cased speaker. It is mounted up on the firewall and does not interfere with the normal car radio. The small control unit is mounted under the dash. Two types of microphones are available. The small military type mike is used in a large number of systems but the handset type is more popular in oil field use because the receiver adds a great deal to the readability of a signal when the car is going fast or in a noisy location.

Rig Stations

The rig unit is usually a mobile unit mounted up in a portable steel cabinet with provisions for supplying power. Instead of the whip antenna of a mobile unit, however, a special coaxial antenna is mounted atop the derrick and connected to the radio by means of a small flexible cable.

The storage battery is mounted at the rear of the cabinet and kept charged by a generator mounted on one of the drilling engines. Steam rigs use a turbine-driven generator and those rigs where 110 volt power, either AC or DC, is continually available can use a converter or charger. While the battery-generator combination is a little more trouble than a straight AC unit, it has the big advantage that while rigging up, or during an engine breakdown, the radio can be operated from the battery for a limited time. If the battery goes down, it is a simple matter to exchange it for a fresh one from a car or truck.

The radio cabinet is normally placed in the dog house beside the knowledge box. So that calls may be heard on the rig floor, a small weatherproof speaker is mounted near the drawworks. The driller can then hear if his rig is being called and step into the dog house to answer.

Office Station

Most drilling companies use a 50-watt office station that is similar in appearance and operation to the rig units. In fact, if good dependable 110 volt AC power is available it could be used on a rig.

Office stations with 250 watts output

are frequently used. The extra power permits the station's signal to be received better in a location where the electrical noise level is high. For example, a mobile unit may be driving along a power line or the station on the rig may be receiving excessive interference from the light plant or magnetos. The higher powered office station does not necessarily increase the two way communications range because the "talk-back" power of the rig or car is still only 50 watts. There are methods of increasing the range in both directions, and these will be discussed later.

The antenna of an office station is usually placed on a tall tower in order to give it maximum range to cars and rigs. This tower may vary from a 40-50 foot pipe mast at a toolpusher's house to a 150 to 300 foot lattice steel tower.

One question is always asked, "Why can't I just put my station antenna on the roof of this office building and save the cost of a tower?" The answer to this is so important that it warrants detailed attention.

While it is true that the frequency modulation type of radio is relatively free from static and certain forms of interference, the interference from diathermy, x-rays, certain motors, neon lighting, etc., can reduce the range by as much as 50 per cent. For this reason, a station with its antenna located in the downtown area of a city will have limited range.

This is not too serious in the smaller towns, but, if at all possible, the station should be located in a suburban or residential area even if the antenna will not be as high as it would downtown. The selection of a "quiet" location for the office station is probably one of the most important items in the planning of a system. If there is any doubt about the location, the noise level of the area should be checked before going ahead with a tower and station.

The office station can be remotely controlled from one or more locations. Thus, the tower and station can be placed in a quiet location on the edge of town and controlled, by means of leased telephone wires, from a downtown office. A second control unit can be installed in a residence, possibly that of the drilling superintendent, to receive night calls.

Now that we have an idea of what the units are, we can discuss what they will do in terms of range.

The very short waves used by these systems are somewhat similar to light in that they can be shielded by hills and the horizon. Fortunately, they bend to some degree, however, and communication is possible beyond actual line-of-sight.

For this reason, maximum range is obtained by having the antenna high and in the clear, keeping in mind, of course, the necessity for having a location free from electrical interference.

The intervening terrain will have considerable effect on the communication range between two stations. The range in hilly or mountainous country is usually very limited unless advantage can be taken of the peaks. The ranges I will describe here are average for the rolling terrain common to most parts of the Southwest.

The antennas on cars and trucks are only a few feet above ground and the range between two such units is seldom more than 20 to 30 miles.

Because the antenna of a rig station is usually 120 to 140 feet high it can send and receive messages to cars 40 to 50 miles away. To another rig or an office station the range will be even greater due to the fact that the antennas at both ends are high. This will be 50 to 70 miles, depending on the elevation of the rigs and the height of the office antenna.

You will frequently hear of ranges considerably in excess of those given above. Due to changes in the ionosphere and atmosphere, there are often temporary increases in range.

Skip Signals

The most spectacular increase is known as "skip" and is caused by the ionosphere, several hundred miles high, acting as a mirror and reflecting the waves from your station back to earth hundreds, or even thousands, of miles away. This causes you to hear stations (and them to hear you) as far away as South America or Africa. Because they come down out of the sky, "skip" signals can be heard in a car as easily as they can at a rig or office station. These conditions occur frequently during the summer and during certain periods of the winter.

The other type of range increase is known as "bending" and is much more useful than "skip." Bending occurs most frequently in the early morning or evening and is due to the moisture in the air causing the radio waves to bend around and over the horizon. It doubles, or even triples, the normal ranges, and communication between rigs and cars 70 miles apart has been obtained. Unfortunately, this bending cannot be depended upon for consistent communication. It may last a few minutes and seldom lasts more than a couple of hours.

However, the consistent range from an office station to cars and rigs can, in some instances, be increased up to 70 and 100 miles, respectively, by using directive antennas. These antennas concentrate the radiation in a given direction and effectively multiply the power of the station by as much as 10 or 15 times. As the same antenna is used for receiving, it picks up the power of the incoming signal by a like amount.

The directive antenna provides this increase in only a limited sector and at the expense of range to the remaining areas. Thus, such an antenna can be used only if the office is primarily to one side of the operation. For example, it would be difficult to use a directive antenna if operations were scattered a considerable distance in all directions from a central office.

A typical example of directive antenna operation is the one used by Fain & McGaha Oil Company at Wichita Falls. It is a 6-element unit, having a power gain of 10 decibels, 300 feet high. With a 50-watt transmitter it provides reliable communication range, in its beam, of 85 miles to cars and 110 miles to rigs. However, the range off to the sides and back is only 35 miles to cars and 50 miles to rigs.

On July 1, 1949, the Federal Communications Commission issued new rules and regulations for the Mobile Radio Service. These rules established a Petroleum Radio Service and provided for the assignment of thirty exclusive frequencies for the use of the petroleum industry.

Until that time petroleum radio had only three shared frequencies on an experimental basis. These three channels quickly became overloaded. In 1947 the Central Radio Committee of the API made formal representation to the FCC for the establishment of a permanent Petroleum Radio Service with additional exclusive frequencies.

Even before these new frequencies were made available, the various petroleum radio users formed a coordinating committee for the purpose of allocating the frequencies within the industry. This will prevent the over-crowding of any one frequency in a particular area and thereby provide maximum utilization of all frequencies. This does not mean that a company can expect to have an exclusive frequency. There are still far too few frequencies to go around and the best that can be done is to spread the companies out as evenly as possible. The sharing of a frequency is not as bad as it first sounds. In fact, for the small radio user it has certain advantages. Authorization can be obtained from the FCC for companies sharing the same frequency to share common facilities; for example, there are several instances where two or more companies share one base station with each company having a remote control unit in its office. Also, in an emergency the rigs or station of one company may relay messages for the cars or rigs of another company that are

▪ CONTINUED ON PAGE 121

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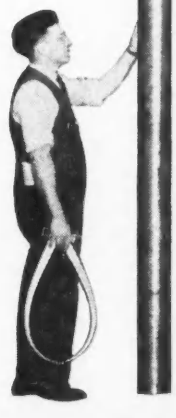

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SAFETY TRAINING By Specific Practice Problems

Part 2. Drilling Rig Safety—Pipe Handling Through V-Door, on Catwalk, and Across

By J. I. POWELL, Consultant

SECOND OF A SERIES on rig accidents and their prevention, this article describes typical accidents occurring when handling pipe through the V-door and involving men concerned with this duty. Hazardous practices are outlined, and recommendations made for safe approach to each situation developed.

THERE have been too many accidents on drilling rigs that were thought of as the result of just another thoughtless act on the part of some poor "bollweevil." These same types of accidents are too often reported in somewhat the same vein of thought.

Where there are no further investigations of accidents made beyond a most easily discoverable element of cause, much valuable information is lost. Efforts to discover the underlying and contributing causes for accidents are thereby hampered. Management's efforts toward developing an improved policy of operation are, likewise, impeded by their not having the proper arrangement of facts to guide them.

The sought-for ends in accident investigation must, during the process, become involved with the human element. That doesn't necessarily say any more than this: even though involved, it still is important to be as impersonal about this phase of the investigation as is possible.

The important thing is to determine the assumed relationship of responsibility found in the thinking and speaking between authority and the workers. This is with regard to the time preceding an accident and also the time following an accident. It is often found that the omission of something that should have been explained is one of the outstanding elements of cause for accidents.

The following analysis of an interview with a drilling rig crewman is illustrative of the thoughts just explained:

Several months ago a lone rig crewman was contacted while he was engaged on a watchman's tour of equipment on a completed well. The conversation drifted to accident prevention on drilling rigs. He said that several months before, and on the very first day he began roughnecking, he was caught in a fouled catline and pulled once over the cathead before the driller stopped its rotation. The muscles in his arm were badly pulled but he was otherwise uninjured.

He said he wasn't working for this same company at the time it happened. In view of this it was felt he would talk about his accident on an impersonal basis. He was asked, therefore, what his driller said to him immediately following his accident. The driller, so the young man related, rushed around to him and said: "Haven't you ever run one of these catheads before?" He told his driller that he had never attempted to operate a cathead before. It was further explained to the driller that he was working his first day on a drilling rig. The driller immediately replied: "Well, if I had known that I would never have put you on that cathead without giving you some instructions."

This beginner was then asked why it was his driller didn't know he was inexperienced. He explained that the toolpusher had brought him out to the well location about mid-morning, took him onto the rig floor and just said to the driller: "Here's you a good man."

The new rotary helper was then asked if he had felt any fear in his attempted action with the cathead, knowing to himself that he had never manipulated a line before. He said he "kinda felt shaky" but that he had lived in oil fields for a long time and had watched so many drilling crews that he just felt like he ought to be able to do it. He had not heard from anyone prior to that time as to just how seriously a man can be injured on a cathead.

The young man was then asked what

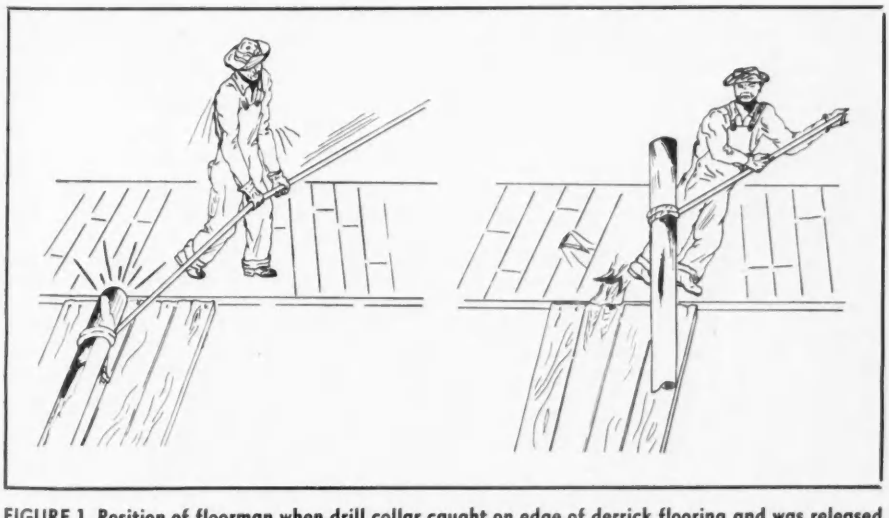

FIGURE 1. Position of floorman when drill collar caught on edge of derrick flooring and was released by breaking out of end of timber, to form a trap with catline and end of collar with floorman between them in the V.

were the toolpusher's remarks when he hired him to bring him out to the well location. He explained that the toolpusher walked up to him and said: "Do you think you can make me a good roughneck?" The young man's reply was: "Yes, sir."

Following this, he was asked if the toolpusher had explained much to him about the operation of a drilling rig while they were riding together from town to the well location. He said their conversation was about almost everything but the drilling of an oil well.

There is no doubt that the toolpusher, had he thought about it, would have lessened the chance of that young man's being injured.

The driller, too, had he not been laboring under the impression that the new man was experienced, would have willingly shown him how to safely manipulate a catline on a cathead.

Had the new employe, through his own experience or that of others, been able to recognize the hazardousness of what he was about to do, he would have refrained from letting his false courage get him into such a situation.

Few accidents have occurred which could not have been prevented with forethought. All too often, however, these valuable thoughts are mulled over for a while by too few involved and then dropped for various reasons.

It is a natural human trait that some participants in, and witnesses to, accidents refrain from saying anything that would reflect too greatly upon the negligence of a fellow worker. It is also natural that some statements given as to the causes for accidents are much too condensed in meaning, and point only to the most obvious cause.

All too often the use of harsh words, giving one-sided reprisals, and irresponsibly placing blame for accidents by superiors cause crewmen to be on guard against saying too much, or admitting having seen this and that. In this connection, it should be remembered that no one will ever be privileged to undo any part of the suffering, or the loss, or the damage, that has already been caused by the accident. It should be understood in this same connection that it is not as important to find a personality on whom the blame can be placed, as it is to ferret out information on accidents that can be used in avoiding a similar recurrence.

It has been found that crewmen will talk more about accident experiences that occurred on some other rig and while working with some other crew, than they will about one they just witnessed in their present crew. If a current accident is being investigated that was connected with, for instance, a particular phase of the Pipe Handling Practice, it is beneficial to encourage discussion on their past similar accident experience or observations.

Valuable information is often gathered in this manner of approach that ordinarily would not be found in a report of investigation. The discussion, at the same time, will assist the crewmen in becoming more able to draw from their own experiences the essentials of working safely while performing those particular acts.

There are hundreds of investigation records, for instance, of accidents that have occurred when some one became fouled in a line on a cathead. There is in these a multitude of constructive training information that can be used to an enormous advantage in accident prevention. In instances where individuals were injured in catheading accidents, and they had not previously been schooled with information that could have been made available, it was not so much the fault of the individual as with the reason for the lack of training.

It becomes increasingly important, therefore, that all past accident experiences be utilized to their fullest extent. These accidents should be classified according to the operational practice the injured party was engaged in at the time of occurrence. Through such a classifying method it is possible to get an entire accumulation of accident experiences relating to one particular practice grouped together.

Designating the Practice

The over-all operations relating to a drilling rig have already been reduced to what shall be termed "specific practices." The guiding principles involved in designating the specific practices were arrived at through a study of 700 drilling rig accident experiences. One of those specific practices will be illustrated.

In the operation of a drilling rig there are certain individual acts and combination of acts necessary on the part of crewmen in getting pipe from the pipe rack to the derrick floor. Another set of acts is necessary in getting the pipe back out onto the rack. The entire group of accident experiences was therefore studied from the standpoint of picking out those particular ones involved with some one of these acts.

The practice designation was set up as: Pipe Handling Through V-Door, on Catwalk and Across Pipe Rack. This can be confusing, particularly where the practice gets onto the derrick floor.

A dividing line must be drawn between an originally started act when an additional act becomes involved with another practice. In other words, if a crewman tails a single of pipe through the V-door that is considered part of the Pipe Handling Practice. If, however, from there he goes on to stab the single into the mousehole, that act will be considered a part of the Stabbing Practice. In this manner, the corresponding types of exposures can be maintained within a group for concentrated study.

The act of manipulating a catline on the cathead, providing the intent is to do something about geting pipe in or out through the V-door, is also considered part of the Pipe Handling Practice. It

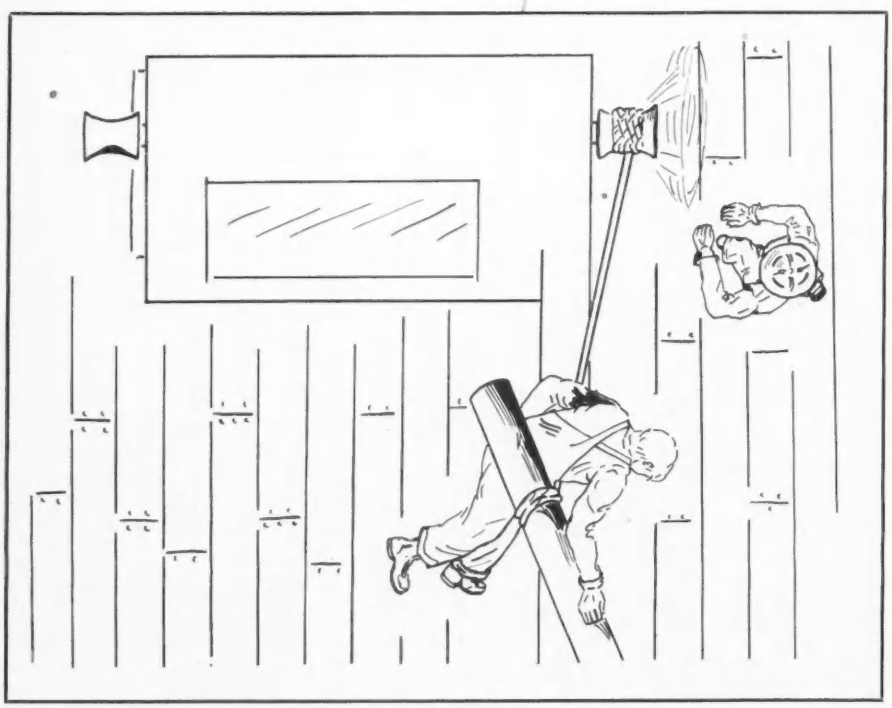

FIGURE 2. When catline became entangled on spinning cathead, V between line and collar was closed, dragging floorman across the floor and into the rotary drive chain guard.

Baash-Ross News

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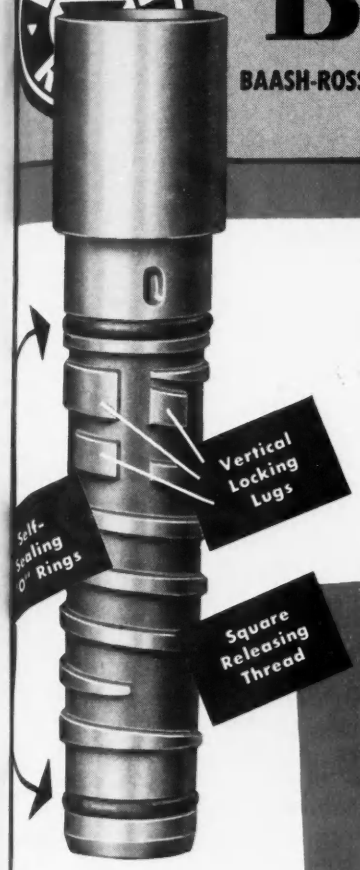

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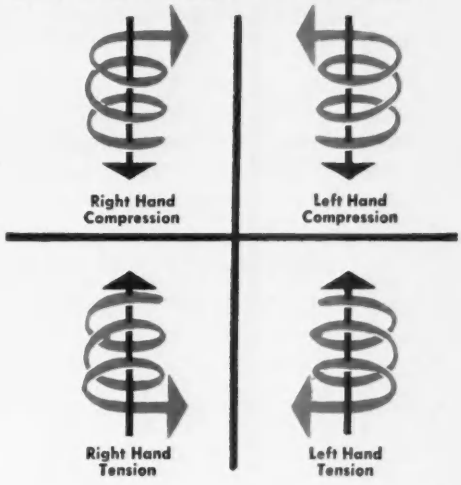


Why run the risk of costly salvage operations every time stuck packers, sanding conditions or similar difficulties jeopardize recovery of your tubing string, when it costs so little to insure recovery by using Baash-Ross Production Safety Joints?

A Baash-Ross Production Safety Joint placed in your tubing string provides a positive means of freeing the string at the point where the Safety Joint is installed, thus permitting important savings to be made in production operations. For example . . .

- **Where production packers are used, a Safety Joint should be installed above the packer to permit positive and complete release of the tubing string should the packer become stuck.**
- **Where sanding conditions exist, one or more Baash-Ross Production Safety Joints should be installed in the tubing string to permit selective release and maximum recovery.**
- **Where it may be desirable to change production methods in a well, a Baash-Ross Production Safety Joint should be installed in the tubing string to permit such changes to be made quickly and easily without disturbing the packer.**

Baash-Ross Production Safety Joints are simple in design, positive in operation and low in cost. They are provided with a unique locking lug that permits heavy rotational loads to be transmitted through the Joint without loosening it—yet disengagement can be quickly made whenever desired by merely following a simple sequence of operations. A choice of *four* different releasing actions is available—either *left* or *right* hand rotation, combined with either *raising* or *lowering* the production string—thus providing the exact releasing action best suited to each production hook-up.

LEAK-PROOF SEAL . . . FULL OPENING PASSAGE

Note in the illustration how the Baash-Ross Production Safety Joint is packed off top and bottom with self-sealing "O" rings to permit circulation through the Joint without leakage. Also, the Joint is full-opening so that rods, tools and clean-out equipment can be passed without difficulty. In fact, the Joint has the same internal and external diameters as the production string itself. Anything that will pass through the tubing string will pass through the Joint . . . and the Joint itself will pass through anything the tubing couplings will pass through—an important consideration when used with certain types of suspensions.

A Size For Every Production Need

Baash-Ross Production Safety Joints are made of heat-treated alloy steel and are available in all four releasing actions to fit all sizes and types of API Tubing. So no matter what the nature of your particular production operations, you can protect against costly recovery or conversion operations by placing one of these efficient Joints on every tubing string.

QUICK POSITIVE RELEASE

Here's how the Baash-Ross Production Safety Joint operates to protect your tubing strings. The Joint consists essentially of a box and pin releasing thread (either right or left hand, as ordered) that is packed off top and bottom with self-sealing "O" rings. In the upper portion of the pin thread, two vertical lugs are machined into the body, and these lugs mate with a corresponding lug machined into the box portion.

The releasing threads are cut with a loose fit—that is, when the Joint is made up, the two portions can move a short distance longitudinally with respect to one another without affecting the vertical alignment of the Joint. This movement permits the mating lugs to lock and unlock as one portion of the Joint is moved with respect to the other portion—and the design of the lugs determines whether the Joint unlocks in tension or in compression. A shear pin is also provided that permits longitudinal movement of the Joint, but prevents premature rotational release.

Basically, the releasing action consists of first unlocking the lugs by lowering (or raising) the string—then rotating the string in the proper releasing direction (either right or left) to sever the shear pin and unscrew the Joint. Only by first moving the string in the proper vertical direction, then rotating it in the correct releasing direction, can the Joint be disengaged—and by properly selecting the releasing action, other tools below can be set and released without risk of disengaging the Joint.

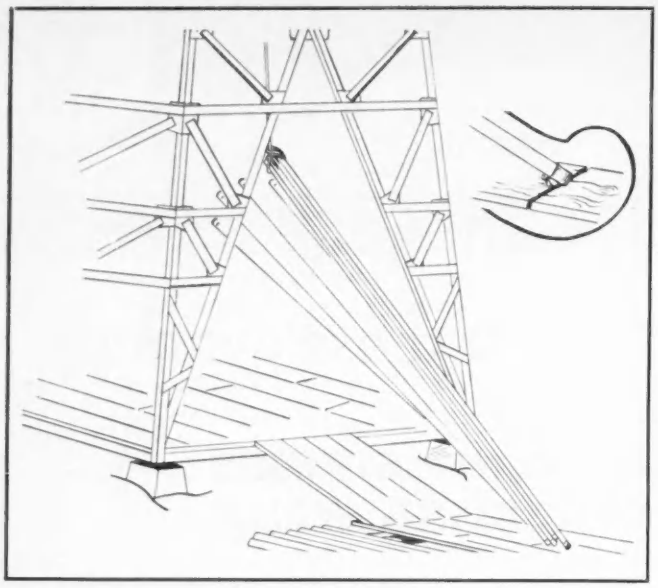


FIGURE 3. Improper securing of joints of tubing in sling can result in one or more joints being pulled free by roughness at edge of floor, with resultant injury to floorman at rotary.

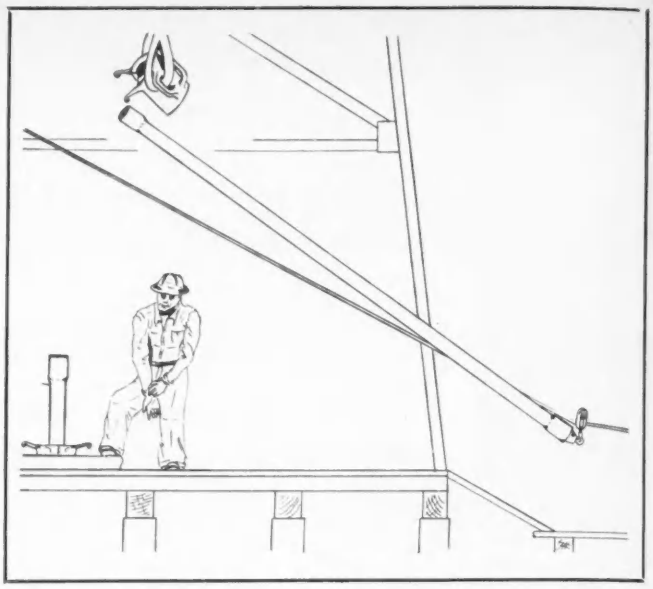


FIGURE 4. Faulty elevators—equipment allowed to be operated when not in good repair—caused this joint of pipe to be jarred free after lower end had been picked up by runout hook.

is considered in order also to classify accident experiences that occur on the catwalk or rack with the Pipe Handling Practice that are not actually involved with pipe. In other words, if a crew were engaged in pulling a stabbing board through V-door with the catline and one of the men was injured, that experience is classified with Pipe Handling. The exposures to injury are very similar and by so classifying such accident experiences, they are still confined to the area considered involved with Pipe Handling.

Exposures to Injury by Working Position

It has to be recognized that the overall Pipe Handling Practice is associated with several different kinds of exposures to injury. Therefore in view of this, it was considered advisable to differentiate between these in some way. The method used was to classify accident experiences according to the position the man was working in at the time he was injured. By this method a crewman will be able to know what to be on guard against while working in that particular position.

A crewman, for instance, works in the V-door position on the derrick floor. He handles pipe that is inbound onto the derrick floor and also outbound pipe. An analysis shows that there is a difference between the inbound and outbound exposures with regard to severity and frequency.

Before going into a more detailed analysis, the accident experiences associated with the Pipe Handling Practice will be related to drilling rig accidents generally.

It has already been stated that 700 drilling rig accidents were used in this study. Within the 700 there were found 80, or 11.4 percent of the total, that were involved with the Pipe Handling Practice. These 80 accident experiences were then classified according to position exposure designations. These designations will be set down hereunder, and along with them the associated factual data will be given:

1. Pipe Handling in V-door: Inbound, 11 accidents; principal severity, 2 (both legs and pelvis fractured); 5 eye injuries, 4 minor.

2. Pipe Handling in V-door: Outbound, 15 accidents; principal severity, 1 fatality, 1 finger amputation, 5 bone fractures (including one skull), 2 eye injuries, 6 minor.

3. Pipe Handling on Catwalk: Inbound, 18 accidents; principal severity, 3 bone fractures, 3 joint injuries, 2 back strains, 2 head injuries, 4 eye injuries, 4 minor.

4. Pipe Handling on Catwalk: Outbound, 5 accidents; principal severity, 3 toes mashed, 1 bone fracture, 1 leg laceration.

5. Pipe Rolling on Top of Rack: 10 accidents; principal severity, 2 finger amputations, 1 bone fracture, 4 joint injuries, 3 minor.

6. Lifting and Throwing Pipe (onto rack, on top of rack, and on catwalk): 11 accidents; principal severity, 4 back strains, 1 shoulder strain, 2 bone fractures, 4 minor.

7. Cathead: 1 accident (arm fracture).

8. Miscellaneous Equipment Handling (on catwalk and rack): 9 accidents, principal severity, 2 bone fractures, 2 back strains, 3 joint injuries, 2 minor.

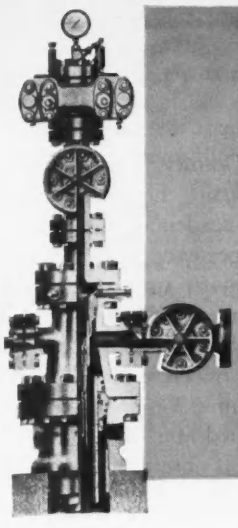
V-Door Position—Inbound Pipe

Crewmen working in the V-door position, while pipe is inbound from catwalk, are subjected to certain and, perhaps, unsuspected exposures to injury. The seriousness of the matter is that the practice, during this phase, becomes very involved with the combined acts of two or more crewmen. In other words, a crewman at this time not only has to depend upon his own judgment and skill to avoid accident producing situations; he also has to depend upon the other crewman co-ordinating along the same line.

An accident to a crewman resulted in both of his legs and his pelvis being fractured and the mid-section of his body badly mangled. This accident could have been avoided by, for one thing, his having taken a different related position to the drill collar he intended to assist over an obstruction.

Two crewmen began preparing to pull a drill collar from the catwalk into the V-door position. They were using a piece of rope, one end of which was tied to the collar, and the other end being manipulated on the backside cathead. In making the first pull, the forward end of the collar was pulled into the end of a floor board at the top of the ramp. The crewman assisting the catheader stepped into a position directly in front of the drill collar. He stooped down and grabbed the pull-in line, intending giving it a yank to assist the radial edge of drill collar over the minor obstruction. At the same moment, the catheader had thrown off some of the wraps and let the pull-in line become slack.

The yanking on the slackened line caused it to foul one of the remaining



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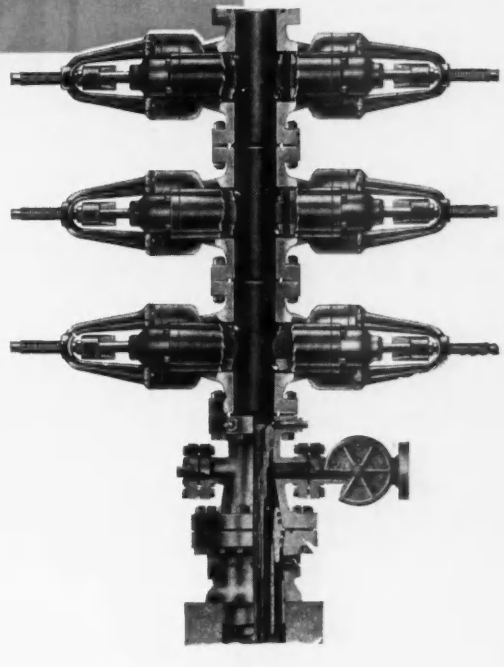

This coordinating of casing nest structure with control accessory equipment provides for completely planned control of flow, both through the annulus between casing and tubing and through the tubing during the performance of the complete sequence of operations involved in the building and completion of a well. It further provides for the removal with control, of equipment as and when it completes its full operating function; and for the assembly of other equipment for use in the performance of subsequent operations in the sequence of operations.

THE WHOLE IS THE SUM OF ITS PARTS

This equipment and method provides for the use of parts and fittings as a coordinated "whole." It avoids the inherent weaknesses which exist and accompany failure to study the whole of a problem in addition to the articles thereof.

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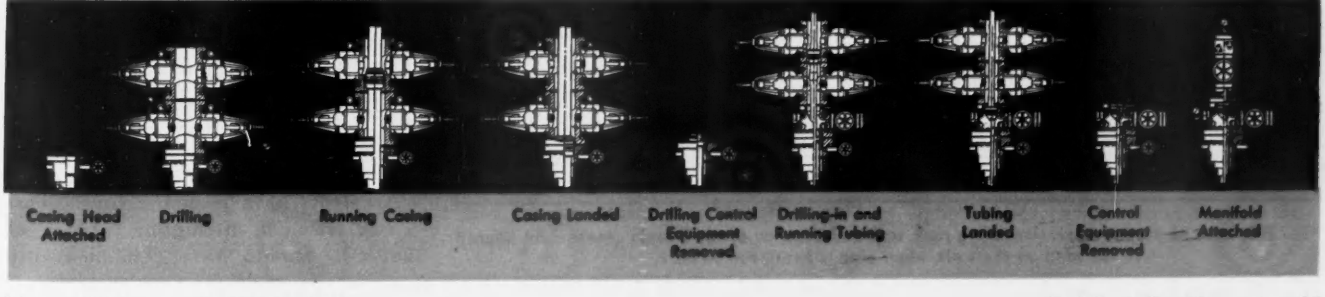

wraps on the cathead. The cathead was turning reasonably fast and thus started reeling in the line. The drill collar pulled over its minor obstruction and in so doing turned slightly sideways. This formed a V-shape between the rope and the end of collar extending beyond the tie. The crewman was caught in this V and it proved impossible for him to escape from it due to the speed with which he was being carried forward. He was pulled into the rotary chain guard.

One of the principal contributing causes for this accident was that the driller was not at the controls of the drawworks when the line fouled. The man who was injured should have used a bar to assist the drill collar over the obstruction. In doing this he should have stood at one side of the collar. The uncoordinated action of these two men, in that of one whipping the line at one end and the other allowing too much slack, contributed also to the fouling of the pull-in line.

Some drilling contractors have already followed a course that holds great promise of eliminating this kind of an accident. They have installed independent hoisting units which eliminate many of the necessities for using the backside cathead. These are drum cable hoisting units. The cable is passed over a sheave on the crown in the same manner as a catline. The units observed were air operated, provided with a reversible mechanism and a hand brake.

Other costly mishaps that have occurred in years past (but were not considered in the analysis) due to a line being fouled on the backside cathead will be briefly reviewed. A casing contractor's cathead man fouled a pull-in line while a casing single was being pulled into V-door. The casing was pulled into the overhead snatch block fastened in top of V-door. The line was parted and the casing fell on and fatally injured two other casers working on the rotary.

In another almost identical mishap the casing, as it fell, hit and fractured the skull of a caser working on the rotary. A legal controversy arose over this incident in which a suit for damages was filed against the drilling contractor. It was alleged that the drilling contractor was negligent in not providing a catline separator guard on the backside cathead.

Another mishap involved a derrick that collapsed when a casing single was pulled into the top of V-door by a fouled pull-in line. The derrick legs adjacent to the V-door framing were buckled inward by the stress of the pull-in line at the same instant the weight of the casing string was picked up off of the slips.

The prime contributing cause for these costly mishaps was that circumstances did not permit the driller to know that the lines were fouled on the backside cathead—sufficiently in advance of the resulting mishap—to stop the rotation of the cathead.

Another type of accident that occurs during this phase of the Pipe Handling Practice happens when a thread protector hangs either on a high board joint or nail head in the catwalk. Tubing singles have thus been drawn out of bundles being pulled into the V-door with catline. These tubing singles have fallen and struck the unsuspecting crewman standing beneath and to one side of the overhead bundle of tubing singles.

From a prevention standpoint, the catline tie around tubing bundles being handled in this manner should be made more secure. A safe, maximum number of tubing singles that should be handled in this manner should be decided upon. High board joints in catwalk should be beveled to a gradual slope and nail heads kept countersunk into the boards.

Accidents have been the consequence of one crewman attempting to do a job that two should have combined their

About the Author

JAMES I. POWELL was born in Palacios, Matagorda County, Texas, and spent much of his boyhood times assisting his father in drilling water wells. Along with his academic schooling at San Marcos Academy, practical experience was gained as an operator of steam and diesel power units; also in the maintenance of electrical, water and plumbing systems. Several years were spent as a traveling electrician with the Southern Pacific Railway. He entered the oil industry with Humble Oil & Refining Company and drilling and production activities carried him into Southwest Texas and Louisiana. Some of his observations and experiences were published in *The Oil Weekly* during 1938. He joined Aetna Life Affiliated Insurance Companies in 1939 to aid managements of the insured companies in their loss prevention problems. He has worked in the Permian Basin and East Texas for the past ten years.

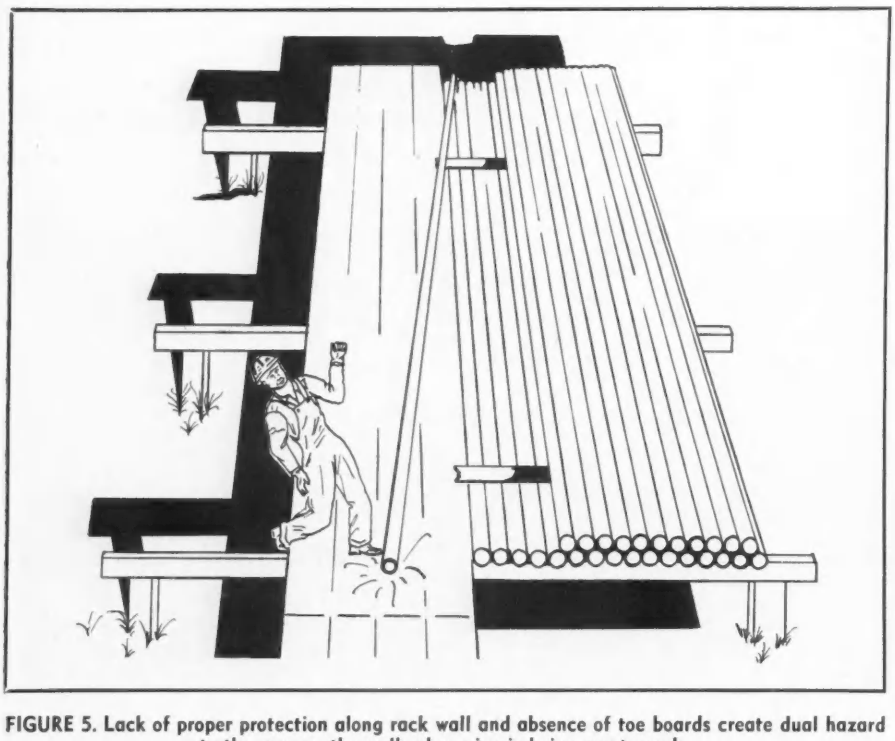

FIGURE 5. Lack of proper protection along rack wall and absence of toe boards create dual hazard to the man on the walk when pipe is being run to rack.

efforts in doing. A lone crewman will sometimes turn the cathead end of the catline loose from its fastening. He then will go to the pickup end of the catline and pull sufficient slack to carry the end down to the catwalk. There he will tie it onto a drill pipe single. There have been instances while this act was being completed where slack ran down on the pickup side of the catline, fell onto the spinning rotary drive bushing, and became fouled. As the catline was being wound up around the spinning drive bushing, it was at the same time pulling the pipe single onto the derrick floor. Crewmen have been caught between the ends of these pipes and the spinning rotary and seriously injured.

The cathead end of a catline should never be loosened from its fastening and pulled by its pickup end, particularly while rotary is spinning, unless another crewman is at the cathead end to keep the slack from dropping onto the spinning rotary.

V-Door Position—Outbound Pipe

That phase of the Pipe Handling Practice connected with a crewman's acts while working in the V-door position, when pipe is outbound from derrick floor, has its peculiar exposures. Records indicate a serious exposure is involved with the actions engaged in while singling-down drill pipe.

A crewman was fatally injured as a result of the overhead elevators opening up and allowing a drill pipe single to fall free. The box-end of the single was about 20 feet up when it began falling. The pin end had already been placed on the singling-down trolley hook. The trolley cable was allowing the pin-end to sway from side to side. The box-end did not fall in a perpendicular line from the elevators, but to one side where the crewman was standing. The elevators opened only after their latch side top was tilted forward by the angle created by the single going out through the V-door. The falling pipe struck the crewman on the head.

The elevators were examined after the accident, and it was found that their hinge and latch pins were badly worn. The latch spring was weak. The contact-locking surfaces of the latch and latch step were dry and gritty. The driller, too, had been holding considerable tension on the hook spring while spinning the drill string off the single. This, of course, caused the box to jump up and slap back several times against the elevators immediately after the pin came out of the lower box threads.

It can only be presumed that some, if not all, of these factors contributed to the opening action of the elevators. The elevators being used in singling-down drill pipe should certainly be put in the very best of physical condition before the job is commenced.

Catwalk and Pipe Rack Exposures

Many of the accidents that occur on catwalks and pipe racks could be prevented through a more determined approach. Improper lifting postures that contribute to strains can be corrected. Conditions that permit men to step off of catwalk during a moment of excitement, in getting out of the way of a fast rolling or swinging pipe, can also be corrected. The space between the edge of catwalk and any pipe that may be on the rack should be filled in evenly and solidly. This will provide a man with a safe stepping place in emergencies.

The mashing of many toes on the catwalk could be avoided if loose cross boards—somewhat thicker than the height of a man's lower instep—were used to hold dropping pipe up above a man's toes.

The tier divider boards on rack should be the same thickness and at least six inches in width. Good housekeeping, both on top of the rack and catwalk and beneath them, is important in reducing accidents.

Rig-to-Office Communication

■ CONTINUED FROM PAGE 109

out of range of their own base station.

All radio stations must be licensed by the Federal Communications Commission. Upon proper application and showing of eligibility, the FCC will grant the license with the frequency and call letters. There is no cost for these permits and the small fellow with one rig and a car can obtain a license just as readily as a major oil company. Before filing for an FCC license it is necessary to obtain a frequency recommendation from the Petroleum Coordinating Committee.

The necessary FCC forms and assistance in their preparation can be obtained from the FCC district offices. Also, the various manufacturers' representatives selling radio equipment have them and are only too glad to help prepare them without charge.

Due to the release of these new frequencies there has been a tremendous flood of applications and the FCC has a rather large backlog. In planning the installation of a system it is well to allow at least six to eight weeks for the processing of the license application by FCC.

Costs

Good radio communication is not cheap, but by effective planning and study, the cost of a system can be kept within reasonable limits. The costs of the individual elements of a system will vary to some degree, depending on type of equipment and labor installation costs. The figures I shall give here, however, are average throughout the Southwest and are sufficiently representative to be used for budget purposes. These costs, of course, include all necessary labor and the various accessories.

The cost of a mobile station installed in a car or truck is about $600. The rig station, with its special accessories such as battery, cabinet, generator, rig antenna, etc., is about $950.

The cost of the office station varies considerably, depending almost entirely on the antenna height required. The tower is usually the most expensive item. A 180-foot lighted tower costs $2200, erected. A 50-watt office station with such a tower will run about $3200.

Thus, a system consisting of four cars, five rigs and an office station would cost a little more than $10,000 installed.

All repairs or adjustments to the equipment must be done by an engineer with an FCC license. It is not necessary to have such a man on your payroll as maintenance service is available on a per-call or contract basis.

Contract maintenance which furnishes all labor, tubes and parts for a flat monthly fee is usually more attractive because the user can set aside a fixed amount each year for his radio maintenance. The monthly rates on this basis vary, of course, depending on the locality, but an average figure is $7.50 per car and $20 per rig or office.

It is unlikely that there will be any major reduction in equipment or operating costs in the foreseeable future. One reason for this is that as more and more users come on the air the FCC technical specifications must, of necessity, be increased to reduce interference. Thus, any advantage gained by quantity production will be offset by the increased cost of manufacturing and maintaining equipment to the more rigid specifications.

It would be nice if, along with the newer equipment, we could get greater ranges for petroleum operations. Such is not the case, however, because the range limitation is an inherent characteristic of the frequencies employed by the mobile service. This is demonstrated by the fact that the range of present day equipment is only slightly greater than it was a few years ago. New types of vacuum tubes and circuit design have helped, but the major improvements have been in developing equipment that will work on a very close frequency separation without interference. As more and more users of mobile radio come on the air the demand for frequencies makes it necessary to assign them closer and closer together. Let us hope that the research laboratories can continue to keep ahead of this radio "squeeze" play.

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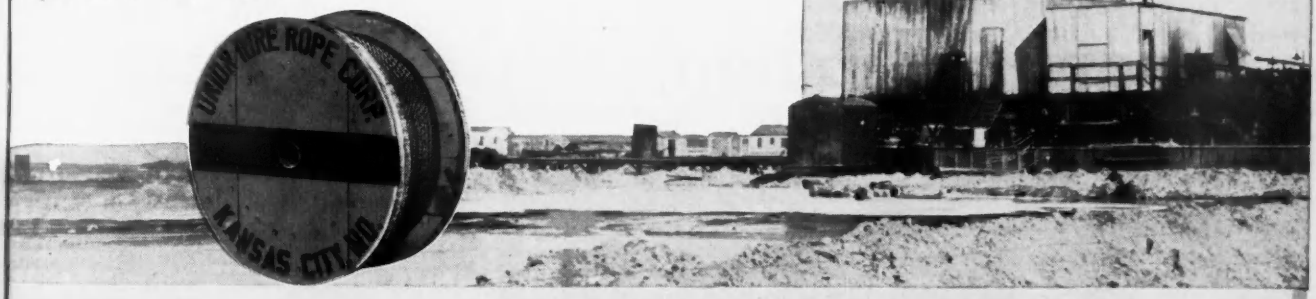

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How to do it!

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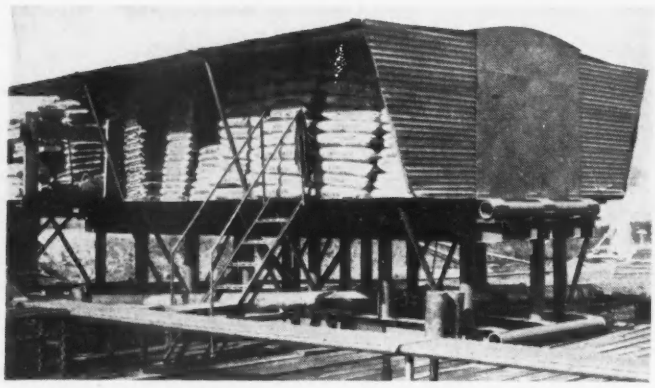
HOW TO—Protect Mud Treating Materials

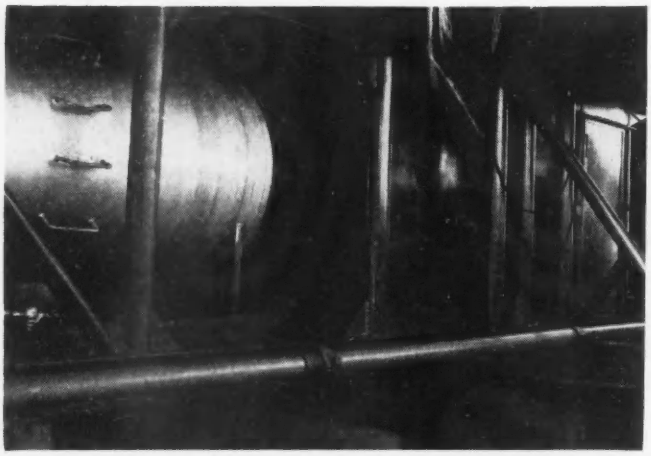


The cost of drilling mud additives makes it imperative that they be stored at the well under protective cover to prevent spoilage. There are many varities of mud storage houses around drilling rigs, but the one illustrated is unusual in size and facility of handling the mud materials.

The mud house itself is fabricated entirely of sheet steel and angle iron mounted on a regular I-beam skid. At the rig, this house rests on a foundation skid made of I-beams and tubular uprights. Purpose of this foundation unit is to place the mud house at such a level that trucks can be loaded and unloaded from it with the truck bed at approximately the same height as the mud house floor.

Capacity of the mud storage house is greatly increased by splitting and hinging the enclosing sides. During transit the sides of the mud house are lowered (the lower section being raised) and secured in position to form a completely enclosed unit. At the new location, the lower panels are unfolded into a horizontal position and braced below to form additional floor space on both sides. The upper sections of the sides are raised and supported by four pipe braces so that a wing roof is made. By adding corrugated metal sheets to the ends, the storage space of the mud house is almost doubled. The extension of the side members to form additional coverage serves to keep out rain. This type of mud house is particularly desirable on wildcat locations where relatively large supplies of various types mud additives must be kept on hand at all times.

HOW TO—Store Equipment Below Rig Floor



Due to the increased amount of equipment required on large power rigs, there is necessarily a corresponding need for extra parts and supplies and a demand for much storage space. Spare parts, gaskets, nuts, bolts, pistons, paint, grease, etc., must be kept in good order to service properly such equipment. To provide the necessary storage for the many parts and supplies needed to keep the mud pumps operating at peak efficiency, the available space below the derrick floor may be utilized to enclose a special pump storage room.

Measuring about 15 x 10 feet, the totally-enclosed pump storage room not only is equipped to handle all the parts and materials necessary to maintain the mud pumps efficiently, but adequate space is also included to work on parts of the mud pumps. A steel door may be locked during rig moves to prevent loss of valuable parts.

Construction of the pump storage room is simplified by the heavy substructure which actually forms the primary supporting members. Heavy-gauge steel plate is welded directly to these supporting members to form a water-proof enclosure. Utilizing as much space below the floor as possible prompted the inclusion of the large-volume air tank shown at left. This tank serves as a reservoir of air for the operation of all air controls on the rig. Sufficient air is contained in the tank to continue operations for some time even after air compressors fail.

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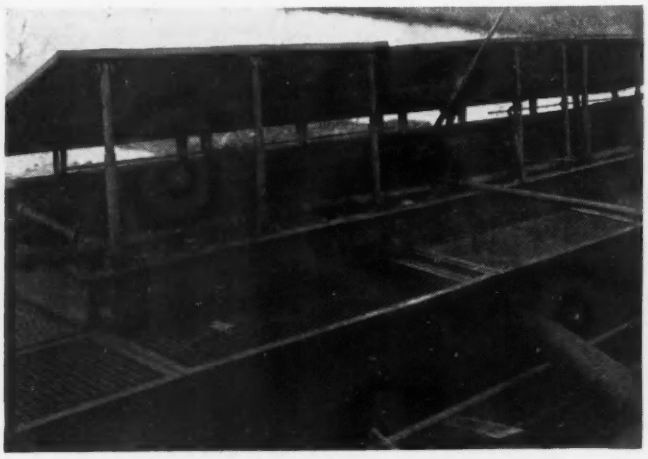
HOW TO—Add Mud Tank Walkways

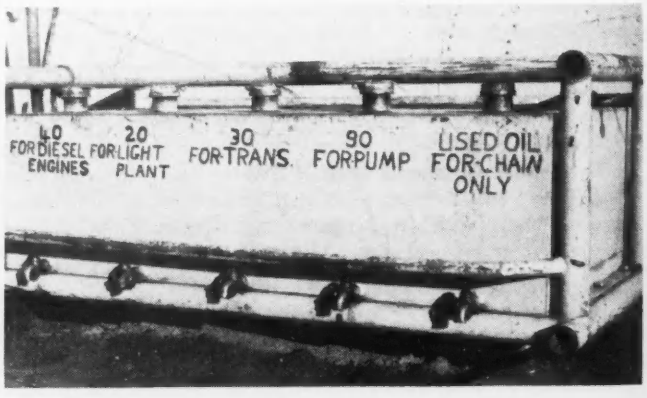


Since the area around a drilling rig is criss-crossed with piping, it has been found advantageous from the standpoint of safety to install prefabricated walkways elevated above all such piping. Where steel mud tanks are employed, it is a simple matter to brace these elevated walkways from the walls of the tanks, thereby eliminating separate pipe frame supports.

Illustrated is one such steel mud tank used on a Gulf Coast rig. Mud pumps are located near the derrick floor and the pits are adjacent to the pumps, with the walkway placed next to the tanks on the pump side. The prefabricated steel walkways, made of angle iron framework covered over with expanded metal, are supported on the tank wall by short metal tabs that hook under the angle iron. Angular braces, also made of angle iron, bolt to the inset near the bottom of the tank. The upper end of the brace bolts to the inside of the angle iron frames, thereby providing a sturdy surface on which to walk.

The walkway is elevated about five feet above the ground, and is the same height as the shale shaker, mud treating platform and mud return line. Each walkway section can be dismantled quickly in preparation for a rig move.

HOW TO—Handle Lubricating Oil



A single tank, compartmented to handle several grades of lube oil most likely to be used around the drilling rig, often has been found to be of greater value than the commonly used rack in which individual drums are mounted. This method utilizes a single rectangular tank measuring 9 feet long, 50 inches wide, and 30 inches deep.

Compartmented to hold five different grades of oil, and with each compartment plainly labeled, the tank is mounted on a framework of four-inch pipe material. A two-inch pipe rail, projecting outward from the front of the tank, protects the row of spigots from injury when loading or when other equipment is being moved in the vicinity.

The contractor has found that time is saved, and far less oil is wasted with this type of installation. There is a slight amount of extra work involved in the emptying of each drum, but this job ordinarily is done when the oil is delivered, it being relatively easy to back the truck up to the tank, and from that level, roll the drum over and drain it into the tank.

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FORMATION AND CASING TESTING

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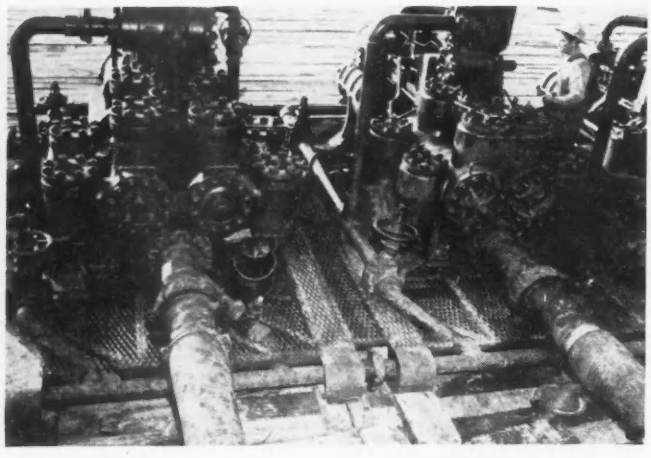
HOW TO—Speed Setting Up Battery of Mud Pumps



Methods of unitizing drilling rigs have been greatly improved in the past ten years, and progress continues to be made along this direction. The rig must be designed so that the integral parts will not exceed highway limitations of weight and size, but these parts must be so equipped that they can be assembled or dismantled without too much loss of time. Here is a versatile battery of mud pumps on a large rotary rig that are so laid out that they can be hooked up with a minimum of lost time.

Following common practice, three large pumps are used side by side. The flexible rubber hoses connect the pump suctions to an elevated mud tank. One of the most interesting features of this mud pump battery is the piping arrangement for speed in assembly and versatility of operation. The end cross pieces of each pump skid are actually part of the fluid system and convey the discharge mud to the standpipe. A close examination of the extreme left pump will disclose a connection from the discharge line back into the suction. This connection, fitted with a valve, makes it possible to compound the mud pumps when required. The discharge from one pump is taken into the suction of another. Such a hookup makes it possible to use any of the three pumps for the high-pressure unit when compounding the pumps.

Steam supply and exhaust lines are similarly incorporated into the skid at the far end of the pumps, with all built-in lines connecting to matching lines by quick-connecting unions. A safe working platform for the crew was added by welding expanded metal to the top of the skid. Space between pumps is also covered with expanded metal.

WORTHINGTON

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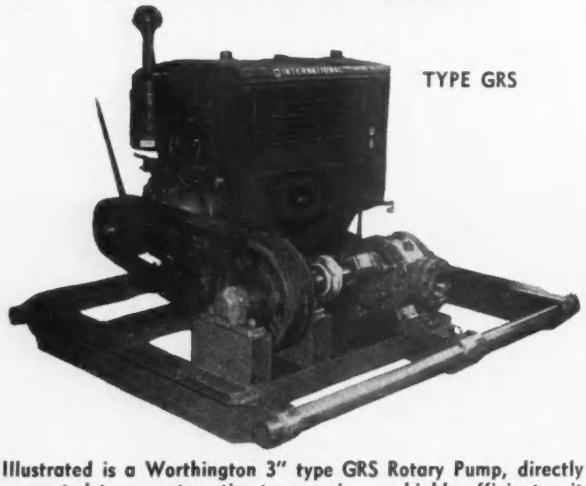
ROTARY PUMP



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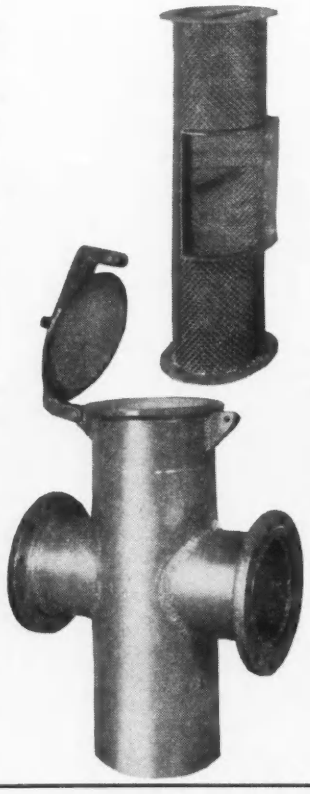

S & R Pump Suction STRAINER

The S & R straining unit is fabricated of heavy woven steel cloth, fitted with solid steel bottom and a flanged top with lifting bar and rigidly framed opening on suction side.

The main steel barrel of the unit is 13⅜" OD, 36" long. It can be furnished with inlets and outlets for 6", 8", or 10" suctions. The straining unit is held in this barrel by a steel plate cap which is fastened to a yoke; flanged ring on top is fitted with an O ring. T handle on top is easily adjusted by hand and assures a pressure tight seal.

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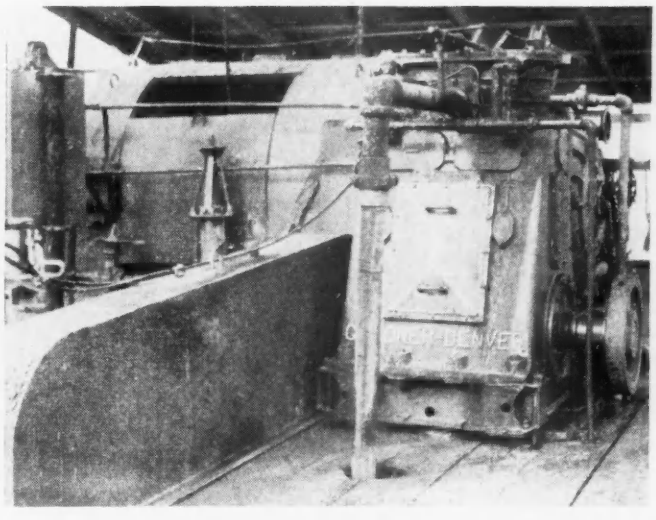
HOW TO—Place Rotary Drive for Improved Visibility

It is of paramount importance that the driller be able to see clearly all operations being carried out on the rig floor. Unless this matter is given careful consideration, the floor may be cluttered up to such an extent that a real hazard exists.

To minimize such hazards where separate rotary drives are employed, this unique arrangement was carried out on one steam rig. The vertical steam engine rotary drive shown is about seven feet from the floor, and if placed adjacent to the rotary, would obstruct the driller's view from the far corner of the rig.



To make as much of the floor as possible visible to the driller, the vertical steam engine rotary drive is set back toward and close to the drawworks as illustrated. It is set directly upon the flooring timbers and bolted to the reinforced substructure below. Special rod linkages connect the steam throttle valve to a handle at the driller's position from which the driller may directly control the rotary drive engine. This arrangement is particularly desirable when rotating to break out a joint of pipe.

The vertical steam engine is connected to the rotary with a regular rotary chain, and one-to-one sprockets. The rotary is supported off the floor so that the sprocket extends only a short distance below the floor level. A sheet metal chain guard set over the rotary chain serves as a protective shield from mud and also prevents the crew from getting tangled in the moving chain. While this special hookup is more expensive than the direct-connected rotary drive, additional visibility is provided, plus more usable floor space where it is needed most—near the rotary.

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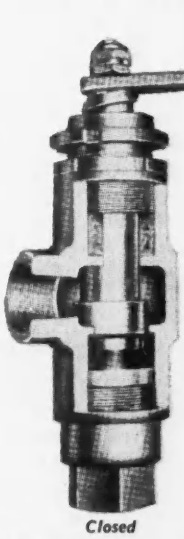

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Many drilling contractors and companies all over the world, wherever they are drilling for oil, are repeat customers for this release valve. Due to its efficient operation, this release valve gives positive seal and release under all pressure and field conditions. There is positively no "kick" when this valve is opened or closed.

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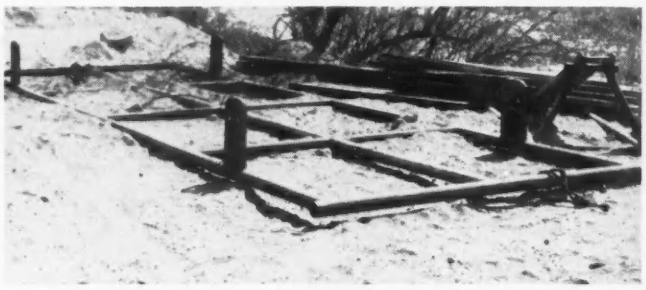
HOW TO—Make Heavy Utility Rack

A handy utility rack which greatly simplifies the transporting and handling of the usually large quantity of miscellaneous piping, timbers and lumber between locations is being used to good advantage by one drilling contractor. The all-welded flat rack illustrated is of legal road width and is constructed of salvaged drill pipe materials.

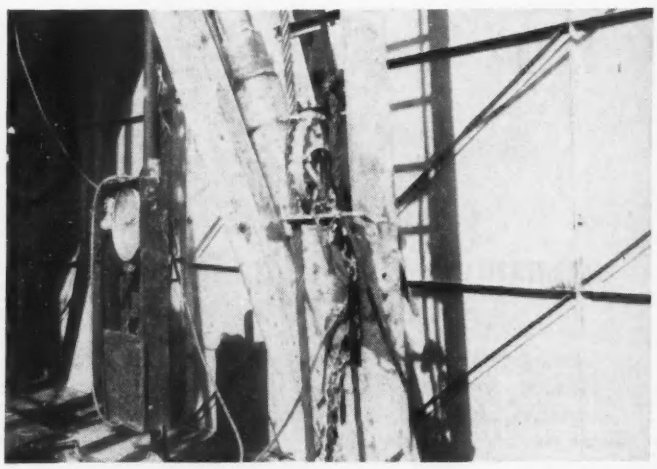


Of considerable importance to the successful operation of the rack are the four upright pieces of steel plate welded to the top surfaces of the longitudinal side members. Of one-inch steel plate, each of these two-foot high uprights has a pair of slots through which wire rope or rods may be run in lashing material to the rack. When loaded, the rack is carried aboard a flat bed truck and may be unloaded near the well during rigging-up operations and later removed to the outskirts of the location while the well is being drilled.

Being of full road width, the rack can carry a large quantity of material without having too deep a pile, making for greater selectivity in sorting and removal of a selected piece of pipe or lumber material.

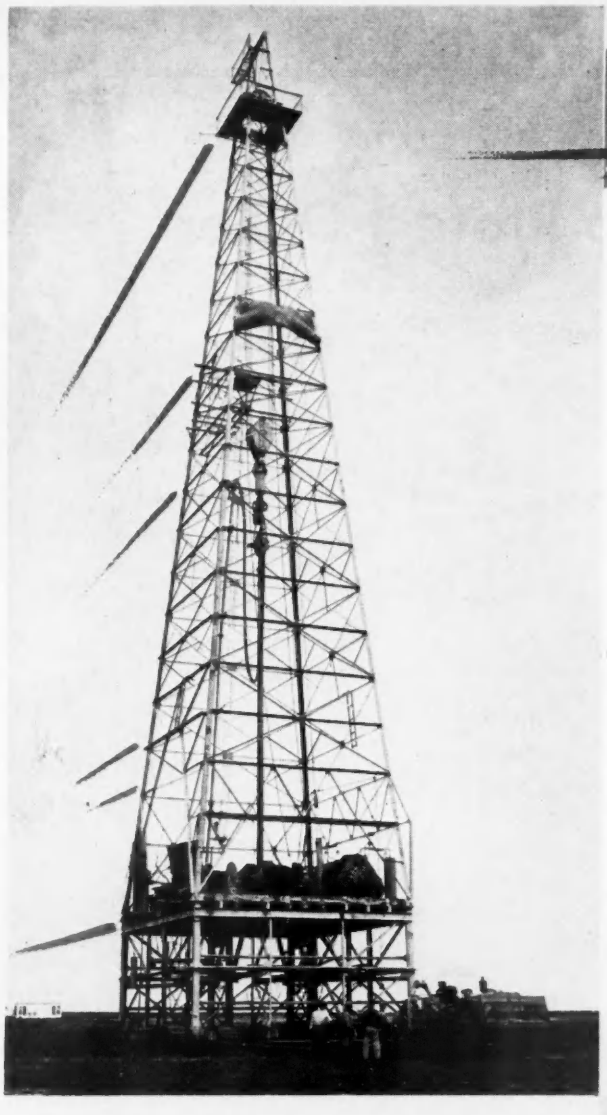
HOW TO—Improve Rig Floor Light

The practice of at least partially enclosing the derrick floor during colder winter months is essential in many areas. Such enclosures serve to cut the wind, enabling floor heaters to be more effective, and thereby increasing the comfort and efficiency of the men on the floor. Enclosures commonly are 8 to ten feet high and often reduce the light which normally would be available to the derric floor, particularly in those areas beside or behind the drawworks.



One drilling contractor operating in the West Texas area solves some of this light reduction problem by painting the inside of the enclosure a bright yellow. Reflected light was increased considerably. With the four walls painted, the light is evenly distributed for no matter at which angle the rig stands in relation to the sun's path, at least one or two walls will catch the light and reflect it back into areas that normally would be in deep shadow. At night, rig lights are more effective.

The comparatively slight cost entailed in keeping these wall surfaces painted is repaid in increased efficiency of crew members and add an incentive to good housekeeping and its application to the floor and rig equipment.



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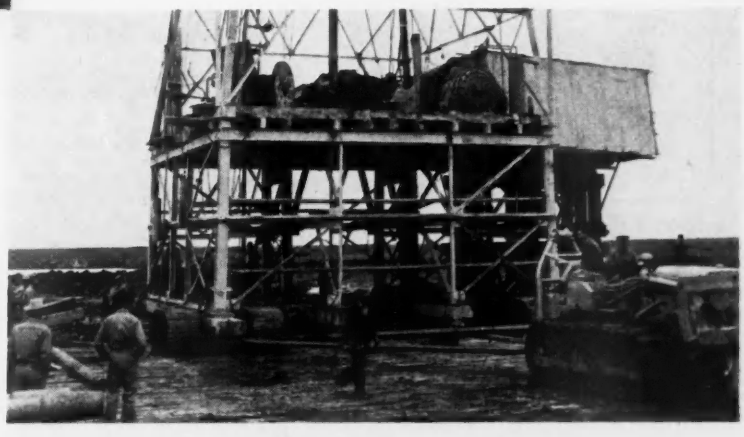
Don't make a move without checking with Sherwood!

Holmes Drilling Company loaded 136' drilling derrick on 14' Substructure makes a quick move at Magnolia Beach, Calhoun County, Texas.



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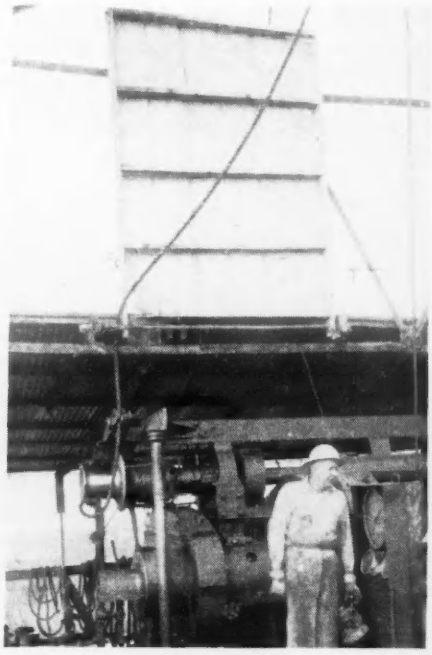
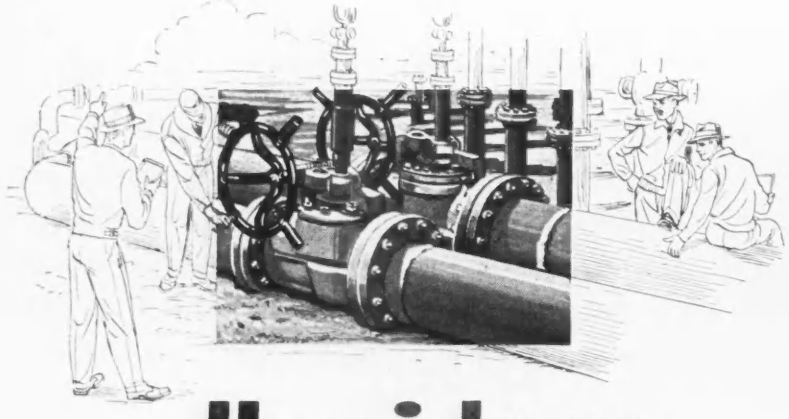
HOW TO—Build Hinged Roof to Protect Driller

During drilling operations, it is necessary that the driller remain at the brake and controls regardless of the weather. Since the drawworks and engine house extend only to the first derrick girt, the driller is exposed to the elements. During good weather, no covering is required, but during rains it is often desirable to have some sort of covering over the driller. Of course, during a trip out of the hole or running casing, any form of covering over the driller which would impair his control of the rig must be removed.



A tool pusher rigged up a hinged roof cover over the driller's position at the drawworks so that the roof could be folded up when not required. The shield is made of aluminum sheets nailed to a 2 x 4-inch frame, the side members of which extend about six inches at one end. Holes which accept one-inch pipe are drilled in the extended pieces so that they match up with similar holes drilled in the rafters of the engine and drawworks roof. When the matching holes of both the cover and the rafters are lined up and a one-inch piece of pipe threaded through them, the cover is fastened in place.

A bridle of discarded sand line is attached to the end of the folding cover and threaded through a pulley bolted to the second girt directly above the roof. The sand line passes between the hinged members and terminates near the cathead where it can be securely anchored. When it is desired to lower the roof cover, the driller need only to pay out the sand line and tie it again when the roof reaches the desired level. The small roof section may also be folded against the derrick by taking all the slack from the sand line.



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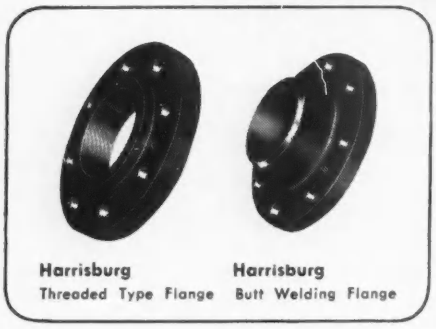

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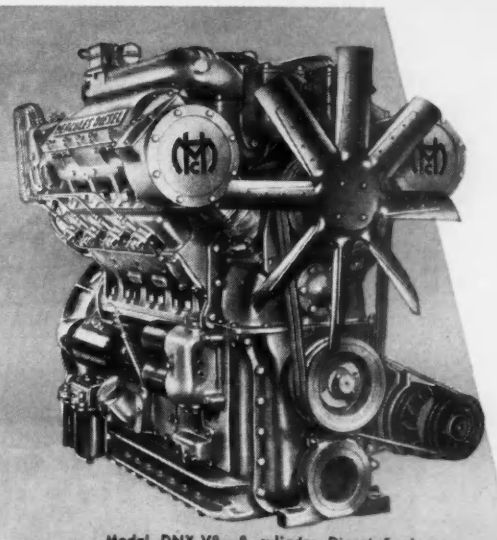

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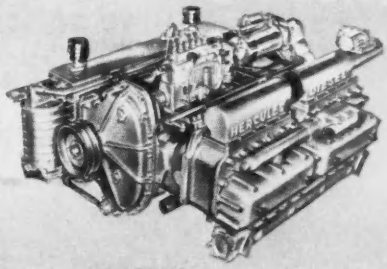
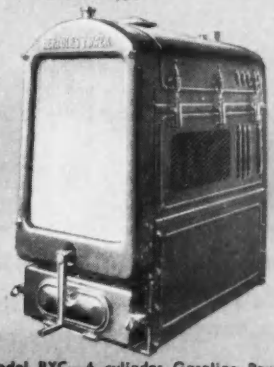


Model DFXHF—6 cylinder Diesel Engine
Pancake Type



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Raw field gas, when obtained from a well without first passing through a standard separator, is apt to carry considerable slugs of liquid which, when they reach the boiler burners or mixing valves of internal combustion engines, can cause considerable trouble.

One contractor, having available a supply of gas from adjacent wells, built up a dryer which delivers gas in a usable state with little attention. The unit consists of a pair of upright cylinders, formed by welding seven-foot sections of 12-inch pipe to a heavy boiler plate with reinforcing angles to relieve the weld of stresses other than pressure. The wet gas is piped into the first cylinder through a two-inch pipe welded through the orange-peeled top of the unit, the delivery pipe being carried nearly to the base plate. Tapped into this cylinder just above the plate is a second two-inch line, equipped with a throttling valve and a lead to a nearby waste-disposal pit. The valve is kept cracked, allowing condensate and other liquids as they collect to be vented by gas pressure within the cylinder.

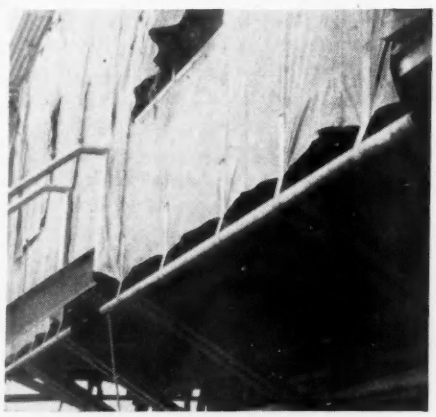
A cross-over connection transfers the gas stream to the second cylinder, the delivery end of the U-shaped connection being carried nearly to the base of the second container. A take-off connection at the top of this unit, fitted with safety valve and Tee for delivery line, completes the unit. A drain line at the base of this second cylinder may be opened

occasionally to remove any liquids which pass the first section of the dryer.

The base plate is welded to cross members of a short skid member, so that the unit is self-supporting and may be shifted to eliminate pipe fitting.

HOW TO—
Hold Down Canvas Windbreakers

Canvas windbreakers, commonly used for enclosing the engine house and sometimes the rig floor area on drilling rigs operating in the West Texas-New Mexico area, often present a maintenance problem. No matter how well the corners are tied and the sides laced, the wind eventually works them loose or tears the canvas, requiring much re-tying and repairing. One contractor has solved much of this trouble by rigging his siding in the manner shown. Strap loops of heavy webbing material are sewed to the bottom of the canvas siding at frequent intervals and a length of pipe is run through them. The constant weight of this length of pipe, distributed over the entire length of the panel, eliminates concentration of



stress at any one point or seam, thus prolonging its life and effecting a better sealing-off of the outside cold air.

By making the siding a foot or so longer than actually is needed to cover the opening, the tautly stretch canvas will form a good contact with the edge of the floor and allow the pipe weight to swing freely without bumping into any part of the rig. A further advantage of this type of installation is the greatly reduced amount of labor required in rigging-up or tearing down. By simply removing the pipe and unfastening a few side and top fasteners, the panel may be taken down and rolled up ready for transporting to the next location. The pipe sections may be painted an identifying color, and are carried along with other tubular goods moved with the rig.

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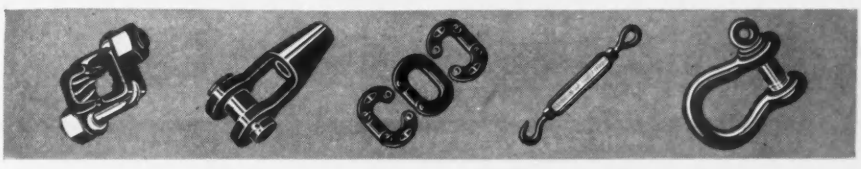
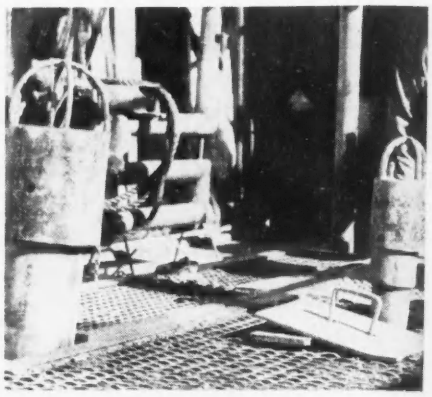


HOW TO—
Prevent Scuffing Of Rotary Hose

On small rigs where floor space is limited, special care must be taken to see that the rotary hose does not rub against sharp objects or rig equipment when a joint is drilled down. To prevent injury to the hose caused by striking the sharp edges of the rat hole pipe or the projecting tool joint of the drill pipe joint standing in the mousehole, one contractor had special caps made which would fit over these two projections.

These caps are made of short lengths of casing slightly larger in diameter than the pipe on which they are placed. Each cap is closed at the top and is provided with a rounded, four-legged arch made of round steel rod. The rounded surface of the cap easily deflects the vibrating and swinging rotary hose when it comes down that close to the rig floor. The caps also serve to keep objects from being accidentally dropped into the openings.



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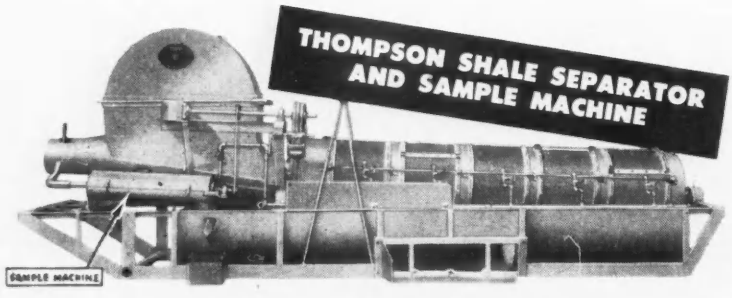

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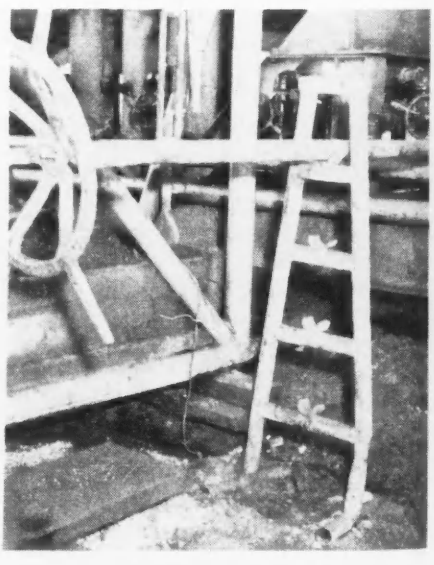
HOW TO—
Support Handle of Blowout Preventer

A simple, quickly-rigged support on which the blowout preventer extension handle may be rested can be fabricated by the company welder. The all-welded support is made of salvaged two-inch pipe material and is constructed in ladder-like fashion to provide for any variation in ground level or relative changes in height of the preventer, these conditions being subject to change from location to location. Atop each of the rungs of the ladder is welded a small saddle or yoke on which the handle is rested. Short cross bars on the bottom of the two legs are sufficient to prevent the device from falling over while the handle is being rigged. Once the full weight of the handle rests upon it, the support is amply sturdy.



Corrosion Control

In the Cotton Valley Field

By ALTON J. CARROLL
Engineering Department, Cotton Valley Operators Committee

THE object of this report:

1. To illustrate and explain the program used for controlling corrosion in high pressure, gas-condensate wells of the Cotton Valley Field.
2. To show results of the program to date.
3. To study the economics of the program as compared with previous corrosion costs and as compared with other control methods.

THIS ARTICLE covers the main points developed by the Engineering Department, Cotton Valley Operators Committee, relative to the use of organic chemical corrosion inhibitors in preventing internal corrosion of field equipment.

One of the most important operating problems commonly associated with cycling operations is that of corrosion of field equipment. Huge sums of money are being spent in attempts to prevent or lessen corrosion damage to tubing, well-head equipment, and flow lines. Sub-committees have been organized within the Natural Gasoline Association of America, the API, and the National Association of Corrosion Engineers to investigate and report on corrosion of oil field equipment. The Cotton Valley Operators Committee, Engineering Department is cooperating with these groups in an attempt to find economical solutions to the problem.

The deep, gas-condensate reservoirs in the Cotton Valley field produce gas which is classified as "sweet," but which is corrosive to field producing equipment. Internal tubing corrosion has been and continues to be a serious problem. Numerous cases of parted tubing strings and extensive damage to flow lines and well-head equipment have been attributed directly to corrosion. Alloy materials, baked on coatings, and chemical inhibitors are generally used to control corrosion. The latter has the advantage of much lower initial costs and is indicated to be as effective as other methods.

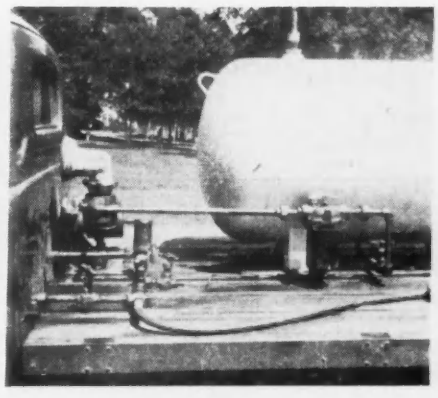
For these reasons, and due to the expected relatively short economic life of many wells in the Cotton Valley Cycling Project, chemical inhibitors were selected as the most economical and practical method for corrosion control in this field. The problem of obtaining or selecting suitable corrosion inhibitors and injection equipment has been approached from several angles during the past few years. Many inhibitors and methods of injecting the inhibitors have been tried and later discarded for practical or economic reasons.

Recently an apparently satisfactory combination of chemical inhibitor and injection equipment has been developed and adapted for field-wide corrosion control by the Cotton Valley Operators Committee. A liquid organic chemical inhibitor is injected in the casing-tubing annulus. Equipment for injecting the inhibitor consists principally of a small, radial hydraulic pump and a 200-gallon chemical tank mounted on a one-ton truck, as shown in Figure 1. With this equipment an average of 25 wells within a six-mile radius of the cycling plant are treated daily.

Test Results

Prior to the selection of the inhibitor now used, this type of inhibitor was tested on an experimental basis for several months. Figure 10 shows results of these experiments which led to the selection of the corrosion inhibitor now used. Flow rate of the well was maintained at approximately 5000 Mcf per day during the experiments. Field-wide corrosion control has now been applied for several months, and test results obtained to date indicate that adequate protection, insofar as internal tubing corrosion and corrosion in well-head equipment is concerned, is being maintained. Measured results obtained to date are shown in the accompanying graphs in Figure 11, which show coupon corrosion rates before and after treatment and the iron content of produced water during treatment.

Table 1 is a summary of the test results. From this summary it may be seen that the average protection indicated to date is approximately 98 percent. The average treating rate of 0.84



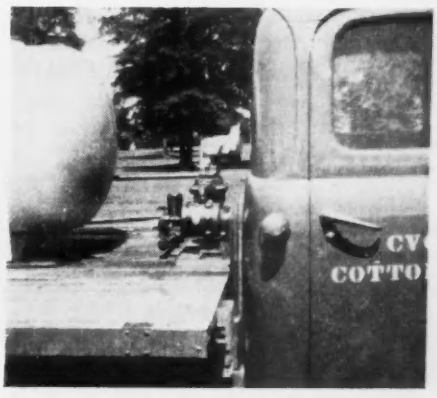


FIGURE 1 (left). Truck-mounted treating equipment. FIGURE 2 (center). Details of equipment arrangement. Copper tubing along floor is used to pressure tank. FIGURE 3 (right). V-belt drive for radial hydraulic pump.

FIGURE 4. Note filter and fluid meter with dial face register on pump suction line.

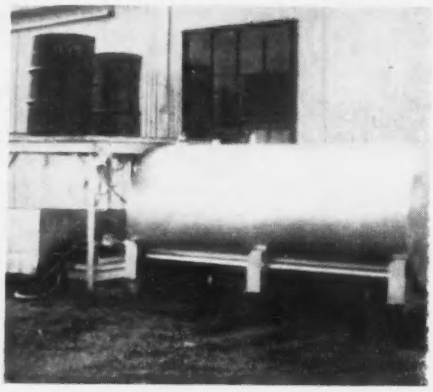


FIGURE 5. Bulk-mixing tank. Gas pressure used for mixing.

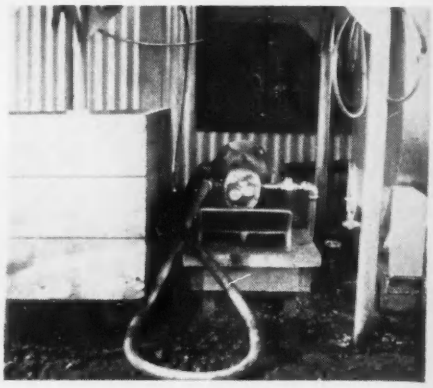


FIGURE 6. Electrically driven centrifugal bulk loading pump.

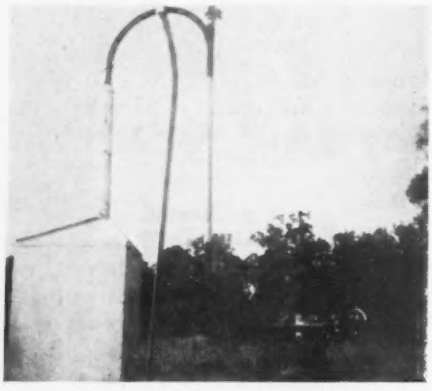


FIGURE 7. Corrosion coupons are installed on top of meter loop.

quarts of inhibitor per million cubic feet of gas produced is somewhat higher than the optimum treating rate expected. The latter test results shown on the accompanying graphs have indicated approximately 98.5 percent protection obtained with a treating rate of about 0.7 quart per Mmcf.

Liquid inhibitors are not used for treating wells which have packers set between the tubing and casing. On these wells, tests are now being made using the inhibitor in a solid form, which consists of one-quart pliable sticks. These sticks are introduced into the tubing string through a lubricator and are allowed to drop to bottom of well while the well is closed in. Upon reaching bottom they dissolve in the well fluids. The well is then placed back on production and the inhibitor adheres to the inside of the tubing string as it travels up the hole.

Injection Equipment

Pictures of the equipment used are shown in figures 1 through 8. A schematic diagram of the injection equipment is shown in Figure 9. In the chemical tank is a mixture of the corrosion inhibitor and diesel fuel. The purpose of the diesel fuel is to provide sufficient bulk for batch treatment and also to furnish lubrication for the pump. This mixture is forced through a filter to remove sand or other foreign material and then goes through a liquid meter into the pump suction. Pressure in excess of 20 pounds per square inch is maintained in the chemical tank to insure adequate flow through the filter, since there is a 3 psi pressure drop across the filter at its rated flow. The small copper tubing line shown as an integral part of the unit provides a simple, speedy means of pressuring the

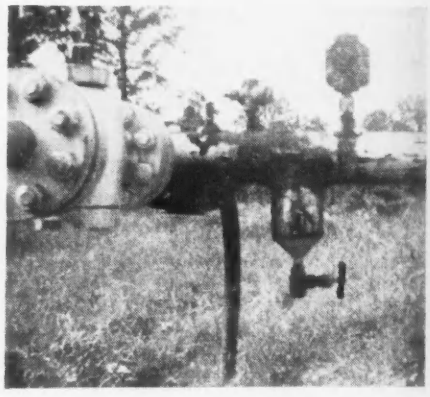


FIGURE 8. Fresh samples of produced water are caught by the trap welded beneath the meter run line.

tank in the field, utilizing well-head pressures. The radial hydraulic pump is designed to deliver five gallons per minute against 3000 psi. pressure, requiring ten horsepower. The pump weighs less than 50 pounds and is of simple construction so that replacement parts are easily installed. Pump driving mechanism consists of V-belts and power take-off from the truck transmission. The 3000-pound relief valve is a safety feature to limit maximum pressure on the discharge line.

The check valve allows fluid to pass in the direction of the well but holds well-head pressure off the pump while the pump is building up to injection pressure. The fluid meter is of the oscillating piston type with a dial face register (showing gallons and tenths of gal-

TABLE 1

Results of Corrosion Coupon Tests, Cotton Valley Operators Committee

WELL	BEFORE TREATMENT			DURING TREATMENT			
	Sand	No. of 2-Week Tests	Average Corrosion Rate MPY	No. of 2-Week Tests	Average Corrosion Rate MPY	Average Treating Rate Qts./ MMCF	Average Iron Content PPM
Crichton No. 2	"D"	4	13.47	9	0.33	0.85	28
Crichton No. 5	"D"	5	10.69	9	0.36	0.77	45
Pardee No. 4	"D"	6	17.05	8	0.16	0.95	29
Crawford No. 1	Bodcaw	6	10.01	8	0.25	0.85	29
Merritt Unit No. 6	Bodcaw	3	4.10*	9	0.20	0.85	15
Mae Pruitt No. 3	Bodcaw	7	15.45	6	0.23	0.79	39
Average all Wells	.....	5	11.80	8	0.255	0.84	31

$$\text{Percent Protection} = \frac{11.80 - 0.255}{11.80} \times 100 = 97.83$$

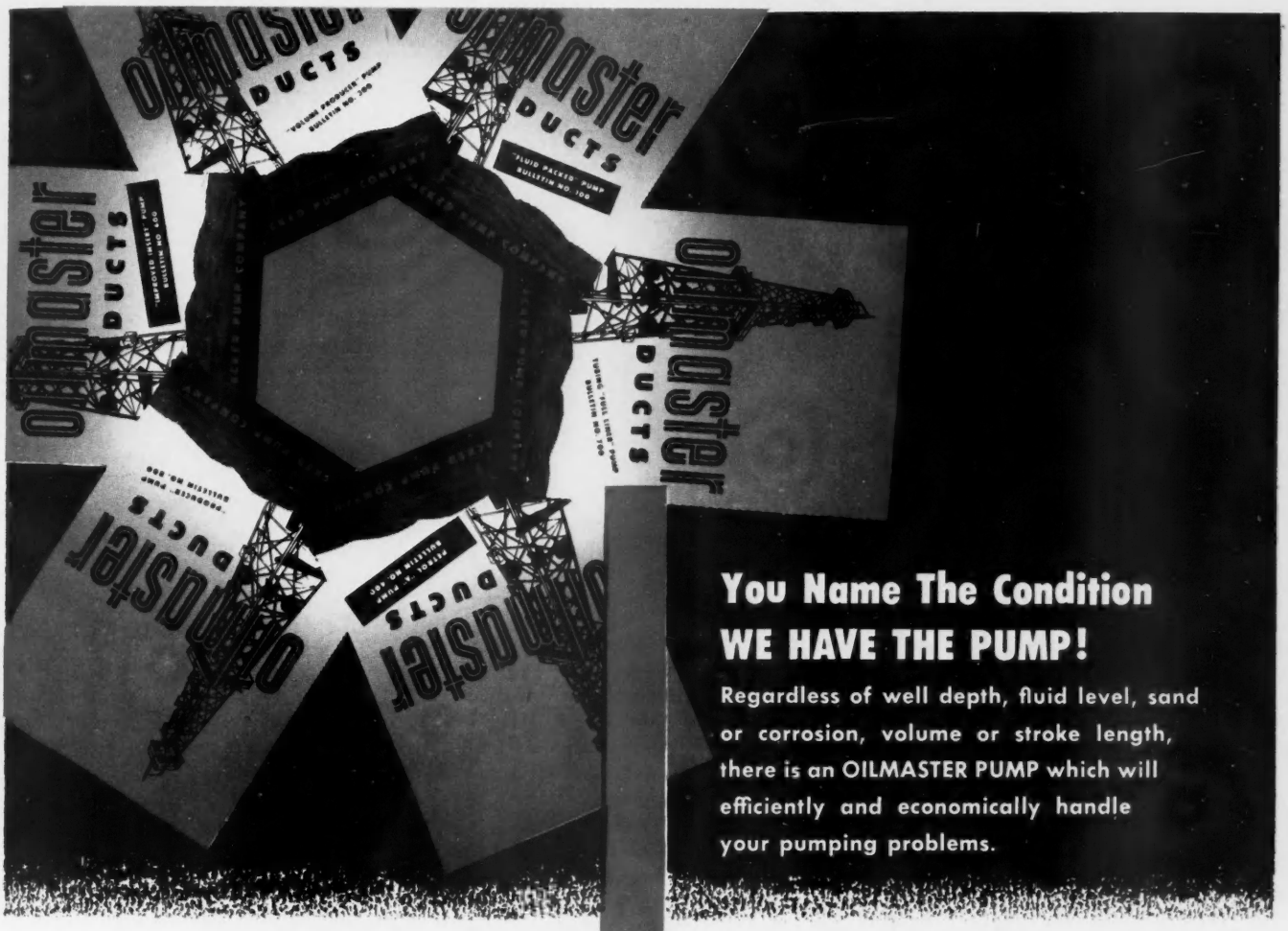
*Well had been treated previously and has not resumed its former corrosion rate of 8.2 MPY before resumption of treatment.

Note: MPY = mils per year penetration. PPM = parts per million.

TABLE 2

Initial Treating Equipment Costs

Pump, radial hydraulic, with foot mounting	$200.00
Filter, 5" shell, 10 gpm @ 3 lb. pressure drop	29.00
Relief valve, 6 gpm, 1000 lb.—3000 lb. range	45.00
Fluid meter, ½", 10 gpm, 150 lb. case with dial register (gallon and 1/10 gallon, cumulative, reset)	62.00
Chemical tank, 200 psi. WP, 220 gal. capacity, welded steel	207.00
Hose, flexible, high pressure, ⅜" x 25', with connection assemblies	17.50
Total	$560.50



You Name The Condition
WE HAVE THE PUMP!

Regardless of well depth, fluid level, sand or corrosion, volume or stroke length, there is an OILMASTER PUMP which will efficiently and economically handle your pumping problems.

"Improved Insert" Pump —The Oilmaster Improved Insert is a full-barrel rod type pump of all-metal construction. The Improved Insert varies from the conventional Full-Barrel Pump in that the Barrel is manufactured from extra-heavy alloy steel tubing. Because of its greater wall thickness, the Barrel is externally threaded, thereby providing maximum economy and adaptibility in assembly.

The Improved Insert Pump because of its greater strength and rigidity is recommended for use in wells producing from below 5,000', or in wells of lesser depth when operating conditions are unusually severe.

"Volume Producer" Pump —The Oilmaster Volume Producer is a full-barrel rod type, all-metal plunger pump designed to provide the largest practical cross sectional area for use in a given size tubing. The Volume Producer is accordingly recommended when large volume wells are to be produced with an insert pump.

Volume Producer assemblies are most widely used in wells ranging in depth from 500' to 5,000'; however, excellent results have been obtained at greater depths when fluid levels were high and pumping conditions not too severe.

Multiple Tube "Fluid Packed" Pump —The Oilmaster Fluid Packed Pump is unique in design and construction in that three telescoping tubes are substituted for the Barrel and Plunger used in conventional all-metal pump assemblies. The Multiple Tube Pump Assembly is a loose-fitting free-falling unit which utilizes the fluid being produced as its packing medium.

The Multiple Tube Fluid Packed Pump is recommended for use in wells that, because of extreme abrasion or dirty well conditions, cannot be economically produced with conventional plunger pumps. Under normal conditions the 12' pump will operate efficiently in wells up to and including 2,000' in depth —the 15' pump 3,500' and the 18' pump 5,000'. For dirty wells in excess of 5,000', the 25' pump is recommended.

Tubing "Full Liner" Pump —The Oilmaster Tubing "Full Liner" Pump is an assembly of standard design, but differs from the conventional tubing pump in that a one-piece alloy steel liner is substituted for the short sections normally used. The tubing pump because of its greater displacement is recommended when it is desirable to produce the maximum amount of fluid through a given size tubing.

The Tubing "Full-Liner" Pump may be safely installed at any reasonable depth; however, for maximum efficiency the surface equipment and rod string must be of sufficient size to accommodate the additional load imposed by reason of greater pump displacement.

Petrol "A" Pump —The Oilmaster Petrol "A" is a small bore, all-metal rod type pump. This assembly was originally designed for use in stripper wells of moderate depth, but due to the excellent wear resistant properties and extra strength attained through the application of the hardened steel barrel, its usage has become widespread in small volume wells of greater depth.

The Petrol "A", while low in price, incorporates precision workmanship with proper design, a combination that meets the demand for economy and performance in a small bore pump.

"Producer" Pump —The Oilmaster Producer is a Full-Barrel Soft Packed Insert Pump designed to operate efficiently and economically under moderate pumping conditions at reasonable depths.

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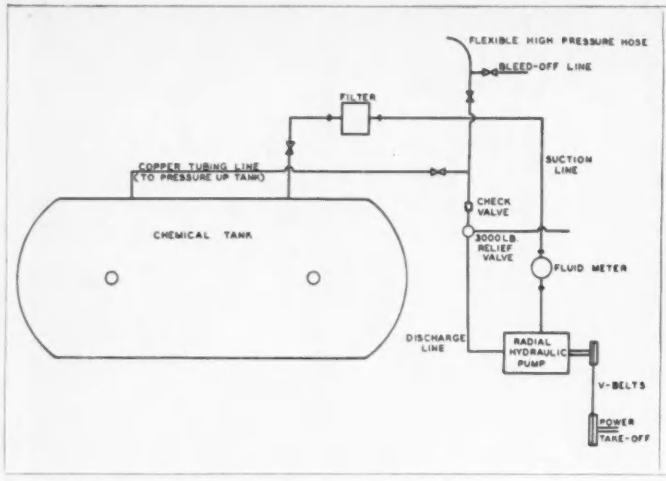


FIGURE 9. Diagram of chemical treating equipment.

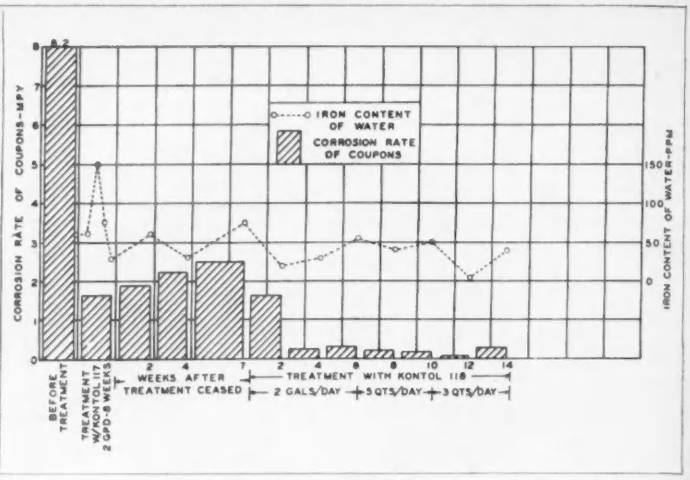


FIGURE 10. Results of treatment to combat corrosion.

lons pumped). The filter is of the permanent, wire screen, full flow type, designed to pass 10 gpm with a 3 psi pressure drop. This equipment has been in continuous service for the past several months and has required only minor repairs. Injection equipment costs are shown in Table 2.

Economics of the Program

The initial costs for Cotton Valley Operators Committee corrosion control equipment were approximately $3500, including costs of the truck with power take-off, pump, tanks, and all accessory equipment. Chemical inhibitor costs are approximately 35 cents per million cubic feet, while labor and equipment costs are about 15 cents per million, making the total costs for the program around 50 cents per million cubic feet of gas produced. The program is considered economically sound, comparing most favorably with published chemical treating costs of approximately $1 per million cubic feet in two similar fields.[1] Total treating costs for the 25 wells are estimated at approximately $18,000 per year, as compared to the average direct charges for corrosion costs to the Cotton Valley Operators Committee during the past two years of $18,843 per year.

These latter charges did not include such intangibles as reduced production efficiency on wells with leaky tubing strings or production lost through damaged or ruptured field equipment. The insurance value of reduced or controlled corrosion damage is also an important intangible asset.

Extensive tests of various alloy materials indicated that 5 percent and 9 percent nickel tubing would withstand corrosion damage very well in the Cotton Valley field. In order to compare the economics of a corrosion inhibitor program as against using nickel alloy tubing, an extreme edge Bodcaw producer was selected and the economics of the two methods studied. In this case it was estimated that the well would produce a total of approximately 11 billion cubic feet of wet gas during the next nine years and, on such a basis, the total treating cost would be approximately $5500. An 8500-foot string of 5 percent nickel tubing would cost approximately $13,000; 9 percent nickel tubing would cost $19,000. It is assumed that the salvage value of untreated nickel alloy tubing would be in the same percentage to initial costs as would the salvage value of adequately protected J-55 tubing. Actually, a complete string of alloy tubing would probably not be required to secure adequate corrosion protection—the top 3000 feet of the tubing string is usually affected more by corrosion than any other part of the string. A combination string, consisting of the top 3000 feet of 9 percent nickel tubing and the remainder of regular J-55 tubing, would probably be economically advantageous in certain Cotton Valley Operators Committee wells. Nickel alloy tubing has probably not been in extensive use for a sufficient length of time to properly evaluate its resistance to corrosion as compared with ordinary tubing; however, there has been reported a failure of 5 percent nickel tubing after only five months of use in a California oil well.[2]

Treating and Testing Technique

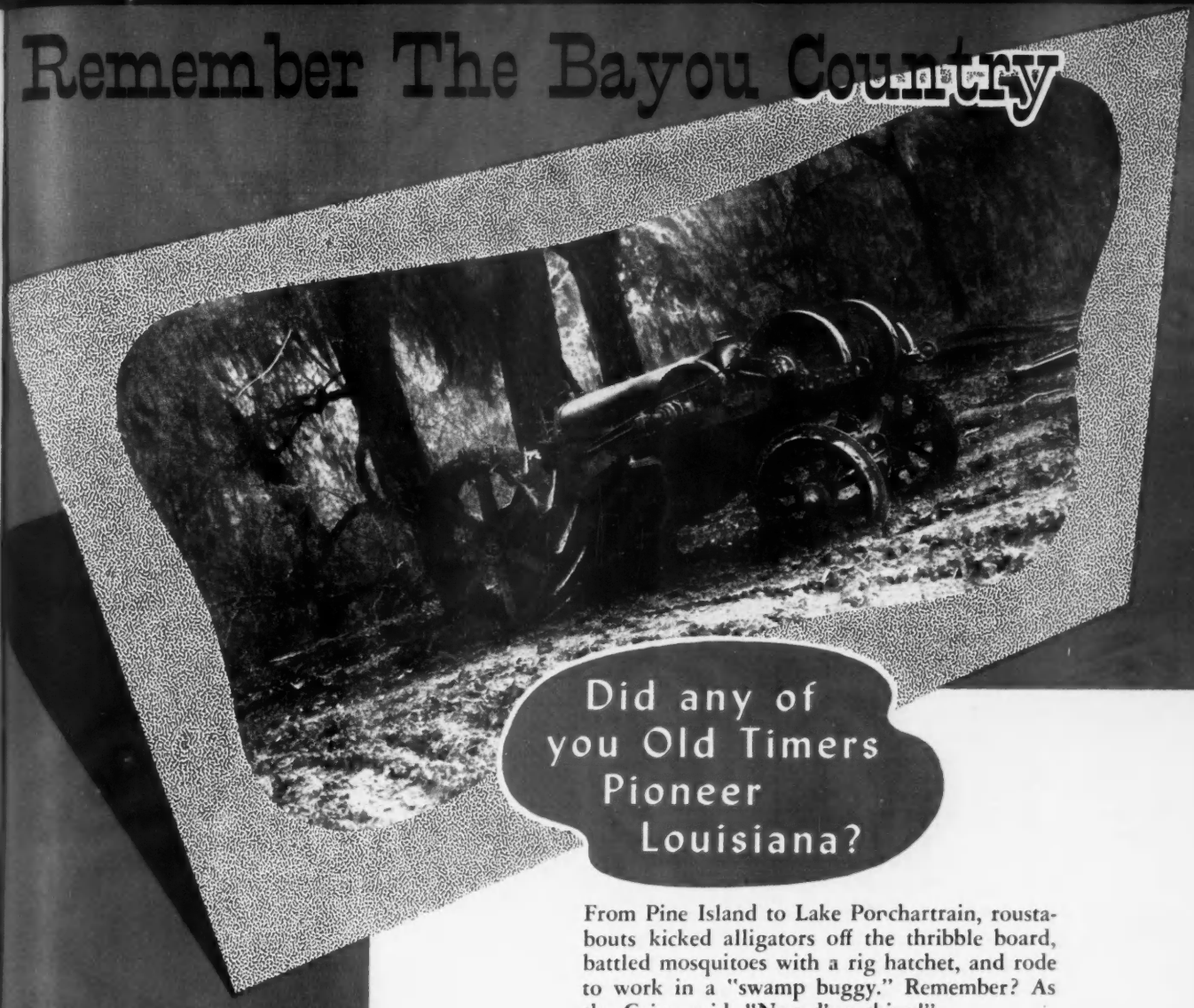
Insofar as possible the producing wells are treated five days per week by the batch method. A predetermined amount of the treating mixture is pumped and metered into the casing-tubing annulus each day, with a double amount being injected on Friday and Monday to compensate for the two days (Saturday and Sunday) when the well is producing but not being treated. The optimum frequency of treatment is now being investigated.

Steel coupons are placed in the flow stream, in the meter loop, of key check wells and are removed at two-week intervals. These coupons are installed and removed by the same man who treats the wells. In order to maintain the proper treating rate, the wells are given double treatment on the day preceding installation and removal of coupons. The corrosion rate is determined from the weight loss of the coupons; therefore, it is important that the coupons be protected from further changes in weight after they are removed from the well. To accomplish this the coupons are coated with a waterproof grease immediately after removal from the well and are wrapped in wax paper.

Fresh samples of produced water are also collected at the time coupons are changed. To insure obtaining fresh samples of water, the water accumulation trap located in the meter run is emptied immediately upon arrival at the well, and the water sample is collected after the coupons have been changed—allowing time for a fresh sample of water to accumulate. To prevent oxidation of the iron in the water a small amount of nitric acid is placed in the water sample before sealing. Application in the field of the waterproof grease on the coupons and nitric acid in the water samples has been found necessary for reliable test results.

The test results, although encouraging, are not conclusive in themselves. Greatly reduced corrosion damage must be obtained before the program can be classed as successful. Such an evaluation should be carried on for at least two years during which time continued studies and improvements should be made. The end result should be a minimum

Remember The Bayou Country



Did any of you Old Timers Pioneer Louisiana?

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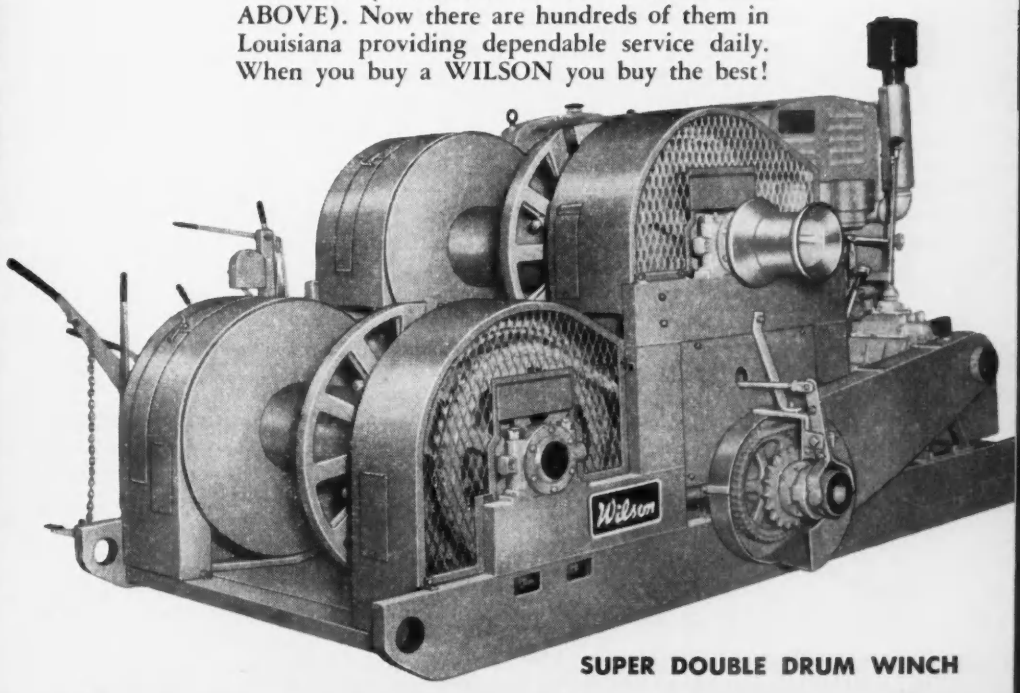

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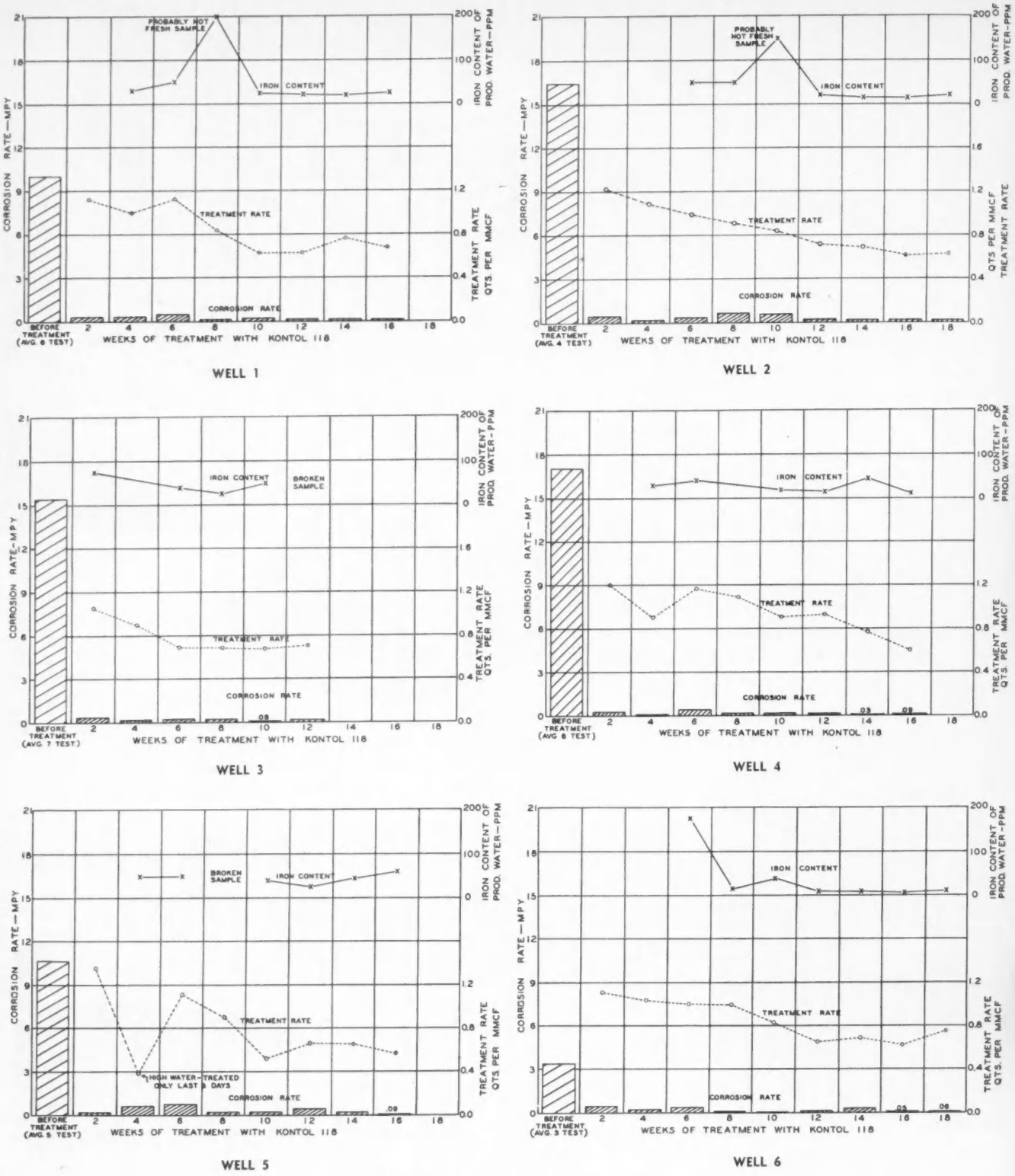

FIGURE 11. Corrosion control test results.

of corrosion damage to tubing strings, well-head equipment, and flow lines. Tubing caliper surveys on selected wells before and after treatment and continued corrosion cost studies will be beneficial in evaluating the corrosion control program.

Conclusions

As a result of this study, the following conclusions have been reached:

1. The present corrosion control program is apparently effective and is economically sound.
   a. Approximately 98 percent protection is indicated for wells now being treated.
   b. Total costs for the program are approximately 50 cents per million cubic feet of gas produced.

(This paper was prepared by Carroll as a report on corrosion for the Cotton Valley Operators. Parts of this report were included in the paper, "Current Problems in Cycling Operations," presented at the San Antonio, Texas meeting of the Petroleum Branch, AIME, October 5-7, 1949, by Ralph L. Hock and Alton J. Carroll. This same paper was also presented at the Tulsa Mid-Continent Section AIME meeting, December 6, 1949. The report, along with other material, was included in a paper given before a joint meeting of the Shreveport Chapter of API and NACE, December 6, 1949.)

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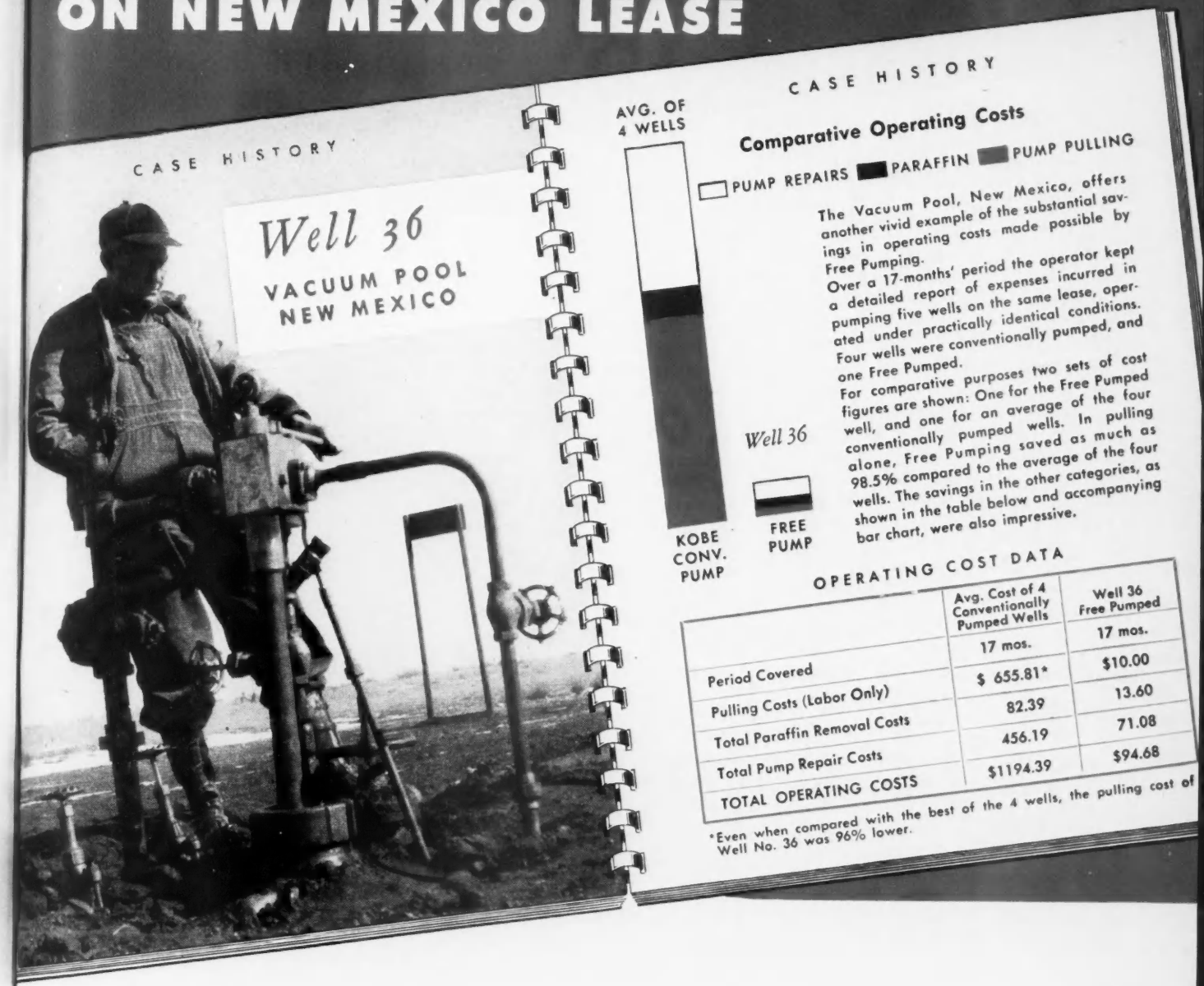
[1] C. R. Ellerts, et al, "Field and Laboratory Tests of Sodium Chromates and Alkalies for Controlling Corrosion in Gas-Condensate Wells," World Oil, July, 1949, pp. 142-150.
[2] Minutes of Natural Gasoline Association of America Corrosion Research Project Committee meeting June 23, 1949, Dallas, Texas.

Free Pumping

REDUCES PULLING COSTS *98.5%* ON NEW MEXICO LEASE


CASE HISTORY
Well 36
VACUUM POOL
NEW MEXICO
CASE HISTORY
Comparative Operating Costs
AVG. OF 4 WELLS
PUMP REPAIRS
PARAFFIN
PUMP PULLING
Well 36
KOBE CONV. PUMP
FREE PUMP
The Vacuum Pool, New Mexico, offers another vivid example of the substantial savings in operating costs made possible by Free Pumping.
Over a 17-months' period the operator kept a detailed report of expenses incurred in pumping five wells on the same lease, operated under practically identical conditions. Four wells were conventionally pumped, and one Free Pumped.
For comparative purposes two sets of cost figures are shown: One for the Free Pumped well, and one for an average of the four conventionally pumped wells. In pulling alone, Free Pumping saved as much as 98.5% compared to the average of the four wells. The savings in the other categories, as shown in the table below and accompanying bar chart, were also impressive.
OPERATING COST DATA

	Avg. Cost of 4 Conventionally Pumped Wells	Well 36 Free Pumped
Period Covered	17 mos.	17 mos.
Pulling Costs (Labor Only)	$ 655.81*	$10.00
Total Paraffin Removal Costs	82.39	13.60
Total Pump Repair Costs	456.19	71.08
TOTAL OPERATING COSTS	$1194.39	$94.68

*Even when compared with the best of the 4 wells, the pulling cost of Well No. 36 was 96% lower.

perators looking for ways to substantially lower pumping operating ost are turning to Free Pumping.

ecause one man alone can surface, change, and run the bottomhole ump, Free Pumping virtually eliminates pump pulling expense nd downtime losses.

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here are other important advantages of Free Pumping. For every roduction problem that arises, the Free Pump operator is able o qualify the source and scope of his problem quickly, easily, and t a minimum of expense.

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Dehydration of Natural Gas

By

R. C. BUCHAN, R. J. SULLIVAN, MILTON WILLIAMS and H. H. SPAIN

Humble Oil & Refining Company

THE DEHYDRATION of natural gas in the field is discussed from the producers' standpoint. The need for reducing the water content of gas to eliminate freezing in gas-lift systems and to meet the specifications imposed by gas purchasers is pointed out. Methods used for predicting trouble are presented. The three principal dehydration methods in use which involve the use of line traps, wet-type units, and dry-type units are described, and the advantages and disadvantages of each method are discussed. This paper is substantially as presented before the Spring Meeting, API Division of Production, at Dallas, March 8-10, 1950.

DEHYDRATION of natural gas has become a necessity in many fields in which high-pressure gas is handled. When the water content of gas is reduced sufficiently, the clogging of lines by hydrates and ice is eliminated. Most gas companies specify a low maximum water content which requires that the producer remove a substantial amount of the water naturally present. Oil producers using gas for gas-lift frequently find that it is essential to dehydrate such gas. The cost of dehydration equipment has been high, but is being reduced as a result of study by operators and equipment manufacturers. The operating cost is low. Dehydration, as discussed in this paper, is defined as the removal of the liquid water present, and some of the water vapor, so as to reduce the dew point of the gas.

Freezing of gas lines, regulators, and chokes in the field has always been a problem to some extent. When relatively low-pressure gas systems were used, trouble was usually encountered only during very cold weather. As the pressures used in gas systems were increased to about 1000 pounds, and as wells having tubing pressures in excess of about 1500 pounds were produced, freezing troubles increased considerably. Until about six or seven years ago, freezing was prevented by heating to keep the temperature of the gas above the hydrate-formation point when passing through regulators and chokes. Heating did not prevent all freezing, particularly in lines downstream from regulator stations where the gas approached ground temperatures which were often below the hydrate-formation temperature. Manually operated drips for the removal of condensed water from low-pressure gas lines were frequently installed and were satisfactory operating aids in many cases. In some isolated instances, alcohol injected into gas lines economically prevented clogging.

The first major problems in the Gulf Coast area were in fields where gas from gas wells operating at pressures from about 1800 to 2000 pounds per square inch was produced into gas-lift systems operating at pressures from 900 to 1000 psi. Heaters satisfactorily prevented freezing through chokes and regulator stations, but continuous trouble was experienced during four or five months of the year, and considerable labor was required to remove hydrates from the gas-lift systems and to produce gas-lift wells. This led to the installation of wet-type gas dehydrators using diethylene glycol as the absorbent.

In 1942, experimental work was started by Humble Oil & Refining Company to determine if suitable drips could be designed for handling such problems. Such devices were found to be feasible and economical in many cases. Later, dry-type dehydrators were marketed and used, and provided a third general method available to producers.

Predicting Trouble

Field experience showed that heating avoided trouble whenever the gas temperature could be maintained above the hydrate point. This was not practical where long lines or numerous lateral lines were in the system, or where the gas volumes handled varied considerably, because in such cases the temperature of the gas remote from the heater approached the ground temperature which was frequently below the hydrate-formation temperature.

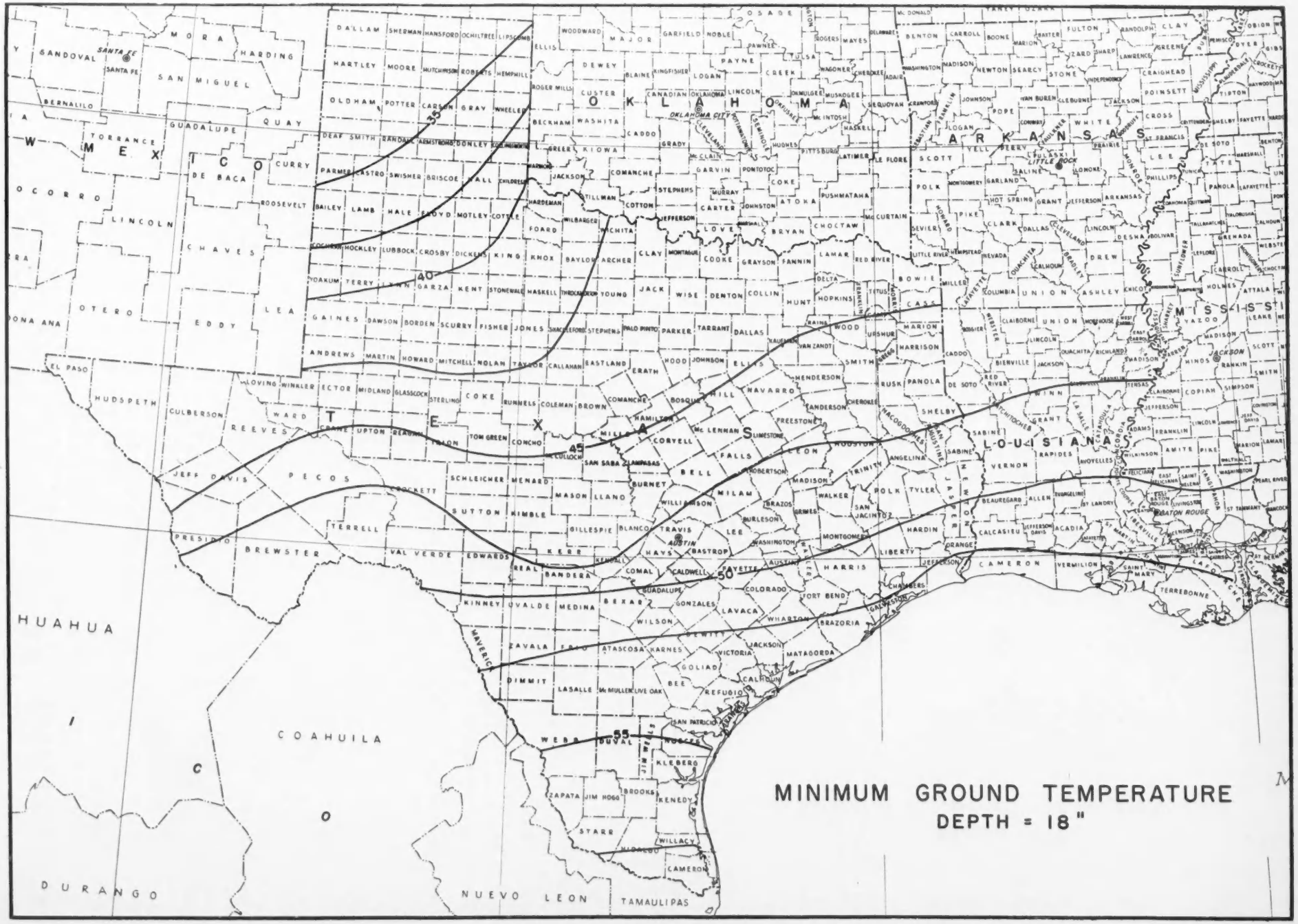
The factors pertinent to the estimation of gas temperature at any given point in a line are:

1. Temperature at point of departure (i.e., at well head or exit of heater, whichever is applicable. For convenience, the point of departure is assumed in this discussion to be well head).
2. Temperature of ground at line depth.
3. Rate of gas flow.

Although the temperature of gas produced from a well may sometimes be estimated from the depth of the well, the bottom-hole temperature, and the flow rate, it is usually advisable to determine this temperature directly.

Figure 1 indicates the minimum ground temperatures that can be expected at a soil depth of 18 inches in Texas and Louisiana. The data upon which this chart is based consisted of scattered measurements of the actual ground temperature, supplemented by the combination of atmospheric temperature data obtained from the U. S. Weather Bureau with data on the relation of ground temperature to atmospheric temperature obtained from various sources. The minimum ground temperature at a soil depth of 36 inches is ordinarily about 5° F. higher than those shown in Figure 1.

After well-head and ground temperatures have been established, the gas temperature at any distance from the well-head may be estimated by use of Figure 2. This illustration is a chart which gives the relation for various rates of flow between the gas temperature at any point along a line and the difference between gas and ground temperatures. The relations utilized in Figure 2 have been deduced from experimental data from various sources which embrace results on line sizes from 2 to 22 inches. Surprisingly, the line size is not an important factor. Although the effect of line pressure is disregarded in Figure 2, pressure does have a minor effect on the temperature-distance relation. Estimates made by use of Figure 2 are reasonably close for gas pressures of about 1500 psi; at higher pressures, the line temperatures estimated from these relations may be slightly low, and at


MINIMUM GROUND TEMPERATURE
DEPTH = 18"
NEW MEXICO
OKLAHOMA
ARKANSAS
TEXAS
LOUISIANA
MISSISSIPPI
COAHUILA
NUEVO LEON
TAMAULIPAS
CHIHUAHUA
DURANGO
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50
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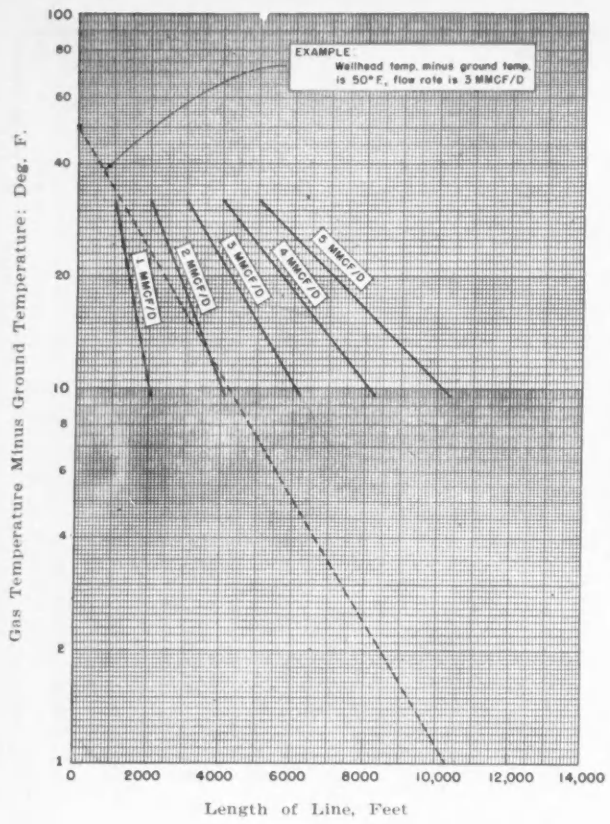
FIGURE 1



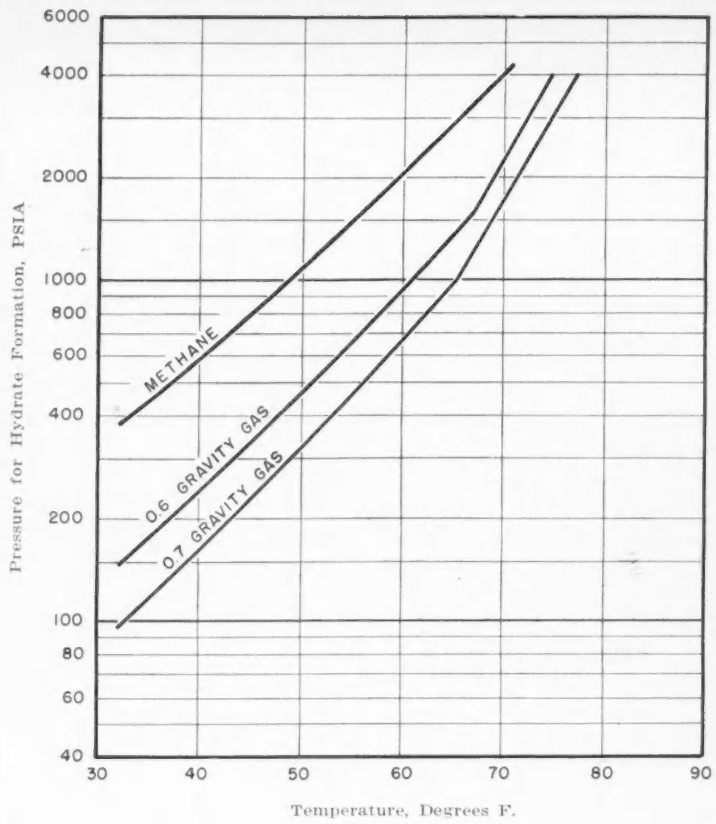


FIGURE 2 (left). Chart for estimating temperature drop along gas lines.
FIGURE 3 (right). Katz's curves for predicting hydrate formation.

lower pressures they may be somewhat high.

The solid lines of Figure 2 are intended only to serve as guide lines. To use the chart, a line parallel to the guide line for the appropriate flow rate is drawn through the point on the ordinate corresponding to the expected or actual difference in temperature between wellhead gas and ground at line level. If it is necessary to interpolate between the various flow rates for which guide lines are shown, a linear interpolation may be made between the intercepts on any grid lines parallel to the abscissa. The relations of Figure 2 are for stabilized conditions of flow; it should be borne in mind that as much as several days may be required for stabilization of temperature.

The use of Figure 2 is illustrated by an example in which the difference between well-head temperature and ground temperature at line depth is assumed to be 50° F., and in which the flow rate is assumed to be 3 Mmcf per day. From the point on the ordinate corresponding to the temperature difference, a dotted line is drawn parallel to the guide line for a rate of 3 Mmcf per day. The dotted line shows the relation between temperature difference at any point and distance from well head for the conditions assumed.

Figure 2 has been very useful for predicting temperatures in systems and for selecting the site of a dehydrator or heaters where a wide choice of locations is possible.

Figure 3 presents data published by D. L. Katz[1] of the University of Michigan for the prediction of temperatures and pressures under which gases of various densities form hydrates. In this graph, the area above any particular curve represents the temperature-pressure region in which hydrates can exist, provided that there is sufficient water present, and the area below the curve represents the region in which hydrates cannot exist. The data used in making these curves were equilibrium data and take no cognizance of unstable conditions under which hydrates fail to form because of lack of agitation or because of the absence of other conditions conducive to hydrate formation.

Maximum Pressure Reduction

Figure 4, from the paper by D. L. Katz,[2] shows the maximum reduction in pressure which can be taken without freezing, in choking gases under various conditions of temperature and pressure. The data of Figure 4 were derived from Katz's hydrate data and information on the reduction of temperature in gases during choking. Figure 4 is useful in the design of mechanical dehydration installations, but should be used only in those cases in which the gas in choked or throttled.

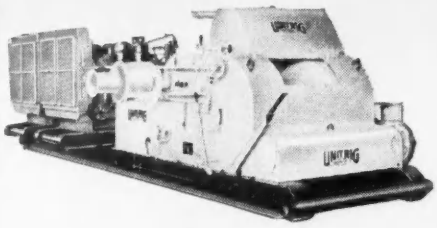
Gas may contain water as water vapor, or as water vapor plus liquid water. The maximum amount of water vapor which a gas can contain is called its water-vapor capacity and depends on the pressure and temperature of the gas. The higher the temperature and the lower the pressure, the greater is the water-vapor capacity. The composition of the gas may also affect the water-vapor capacity, but this effect is usually small and may be neglected in most cases.

The dependence of water-vapor capacity on pressure and temperature is shown in Figure 5. In this figure, the water-vapor capacity is plotted against pressure for a number of different temperatures; the water-vapor capacity is expressed in terms of gallons of liquid water per million cubic feet of gas at standard conditions.

To determine the water-vapor capacity of a gas at a given pressure and temperature by the use of Figure 5, it is necessary only to locate the intersection of the lines representing the gas pressure and temperature, then to read the water-vapor capacity from the horizontal projection to the ordinate of this point. Thus, for example, the water-vapor capacity of a gas at 2000 psi and 100° F. is found to be about 4.6 gallons per million cubic feet. Usually, more detailed charts from Figure 5 are used when studying water contents.

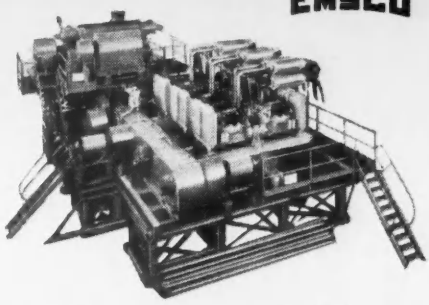
It is important to distinguish between the water-vapor capacity of a gas and its actual water content. The water-

UNITRIG



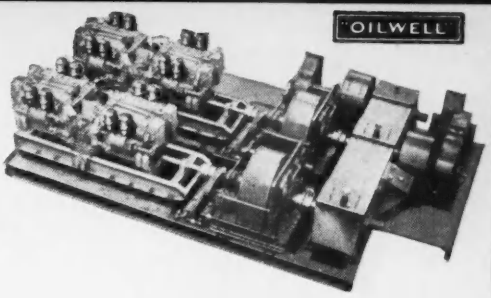
UNIT RIG & EQUIPMENT COMPANY Model U-15 powered with two General Motors Diesel "Twins."

EMSCO



EMSCO DERRICK & EQUIPMENT COMPANY'S Type J drilling rig powered by three General Motors Diesel "Quads."

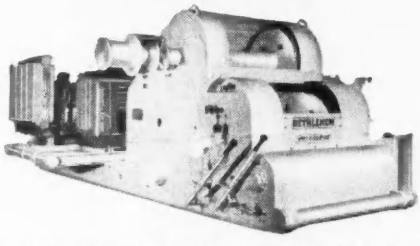
OILWELL



OILWELL SUPPLY COMPANY No. 1500 Dual Pump Drive powered with two General Motors Series 71 Diesel "Quads."

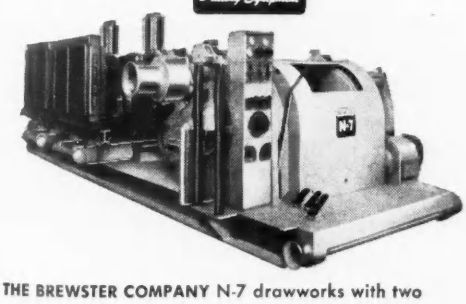
GM Diesels

BETHLEHEM



BETHLEHEM SUPPLY COMPANY "Whirlwind" Hydro-drive drilling unit with upper drum, powered by GM Diesel "Twin" and single six.

BREWSTER
Drilling Equipment



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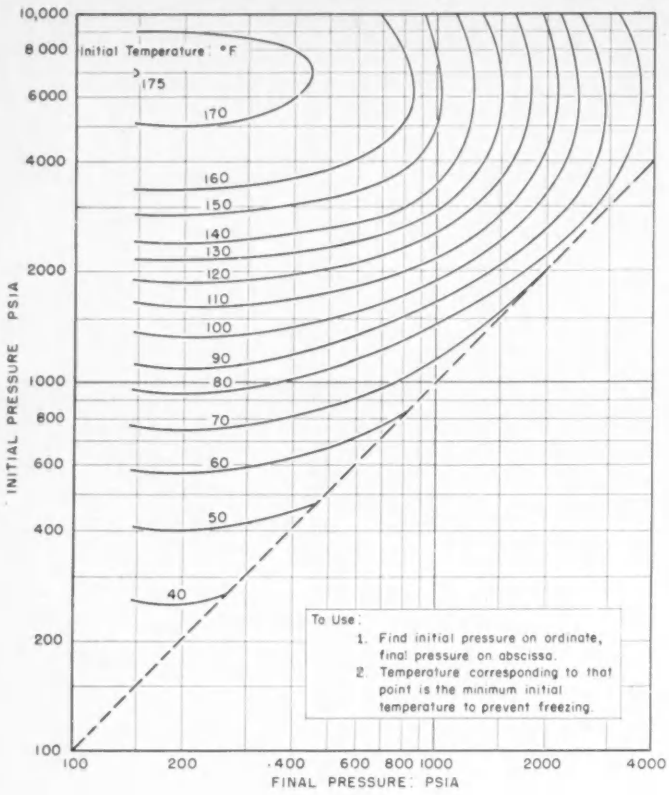

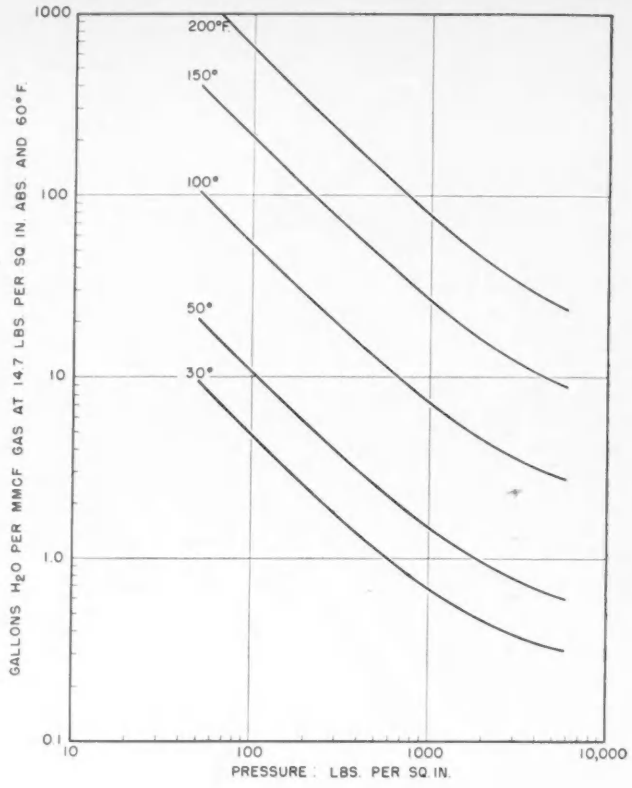

FIGURE 4 (left). Katz's curves for permissible expansion of a 0.6 gravity natural gas without hydrate formation.
FIGURE 5 (right). Water vapor capacity of natural gas.

vapor capacity, as shown in the foregoing section, is fixed by the temperatures and pressure. The water content, however, is not. The water content may be (1) equal to the water-vapor capacity of the gas, when the gas is said to be at its dew point; (2) less than the water-vapor capacity, when the gas is said to be undersaturated with respect to water vapor; or (3) greater than the water-vapor capacity. In the latter case, the excess of water over that corresponding to the water-vapor capacity is present as liquid water.

After the gas producer has determined the temperature of gas at the well or downstream from a heater by the use of Figures 1 to 5, inclusive, he can predict if a problem will develop, and if so, exactly the place and severity of the problem. After a few hours of study, he should be able to select a method to cope with his problem.

The Use of Line Traps

The use of traps or drips installed in gas lines to collect liquid water is old. Devices to automatically bleed the water from traps were used more than 50 years ago. The design and use of traps that utilize the differences in water-vapor capacity at different pressures and temperatures to effect dehydration has been a relatively recent development.

Figure 6 is a schematic diagram of an experimental unit which illustrates how these differences can be utilized.

Gas is flowed from well-head to a line trap where all water present as liquid is removed. Leaving the trap, the gas passes through the heat exchangers where it is cooled. The cold gas, still practically at well-head pressure, then passes through a second trap where water which has condensed out during the cooling procedure is removed. The cool gas is then warmed somewhat by passing through the shell of the first heat-exchange section, and then it is expanded through a choke to a pressure only slightly higher than that prevailing in the gas system. Since the water content of the expanding gas is low, no freezing occurs at the choke. The cooling which accompanies this expansion is utilized to cool the incoming gas by passing the gas emerging from the choke through the shell of the second heat-exchange section. From the shell of the heat exchanger, the gas passes through a regulator into the gas system.

The data in Table 1 show the normal operating conditions and the results obtained with this type of unit.

It is evident from Table 1 that the gas processed under the operating conditions shown was undersaturated with respect to water vapor when it entered the field gas system. The dew point of the processed gas was 40° F.

In order to adapt the equipment to fluctuating demand and to make its operation entirely automatic, various controls were incorporated. A back-pressure regulator was used for throttling the gas in lieu of a positive choke, and a temperature limiter was installed to prevent the temperature in the second trap from becoming too low. When the temperature dropped below any desired value, the back-pressure regulator was opened automatically, allowing the temperature in the trap to rise to normal

TABLE 1

Data on Experimental Trap Installation

Point Considered	Pressure (PSI)	Temperature (Deg. F.)	Water-Vapor Capacity (Gal. per MMCF)	Water Content (Gal. per MMCF)	
				Vapor	Liquid
Reservoir	1900	127	9.8	9.8	0
Well head	1500	74	2.5	2.5	7.3
Entrance to first trap	1500	70	2.2	2.2	7.6
Exit from first trap	1500	70	2.2	2.2	0
Entrance to second trap	1500	50	1.1	1.1	1.1
Exit from second trap	1500	50	1.1	1.1	0
Entrance to field system	875	60	2.4	1.1	0

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Production: 300 B/D
Previous Equipment: Gas Lift

CASE No. 2
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Model 412-9-20A
Pump Bore: 2¼"
Pump Setting: 8,100 ft.
Surface Stroke: 20 ft.
Production: 430 B/D
Previous Equipment: Subsurface Hydraulic Unit

CASE No. 3
PELTON
Model 512-8-30C-P
Pump Bore: 2¼"
Pump Setting: 6,800 ft.
Surface Stroke: 30 ft.
Production: 825 B/D
Previous Equipment: 108" Beam Unit

CASE No. 4
PELTON
Model 412-8-20A
Pump Bore: 2¾"
Pump Setting: 3,900 ft.
Surface Stroke: 20 ft.
Production: 1050 B/D
Previous Equipment: 74" Beam Unit

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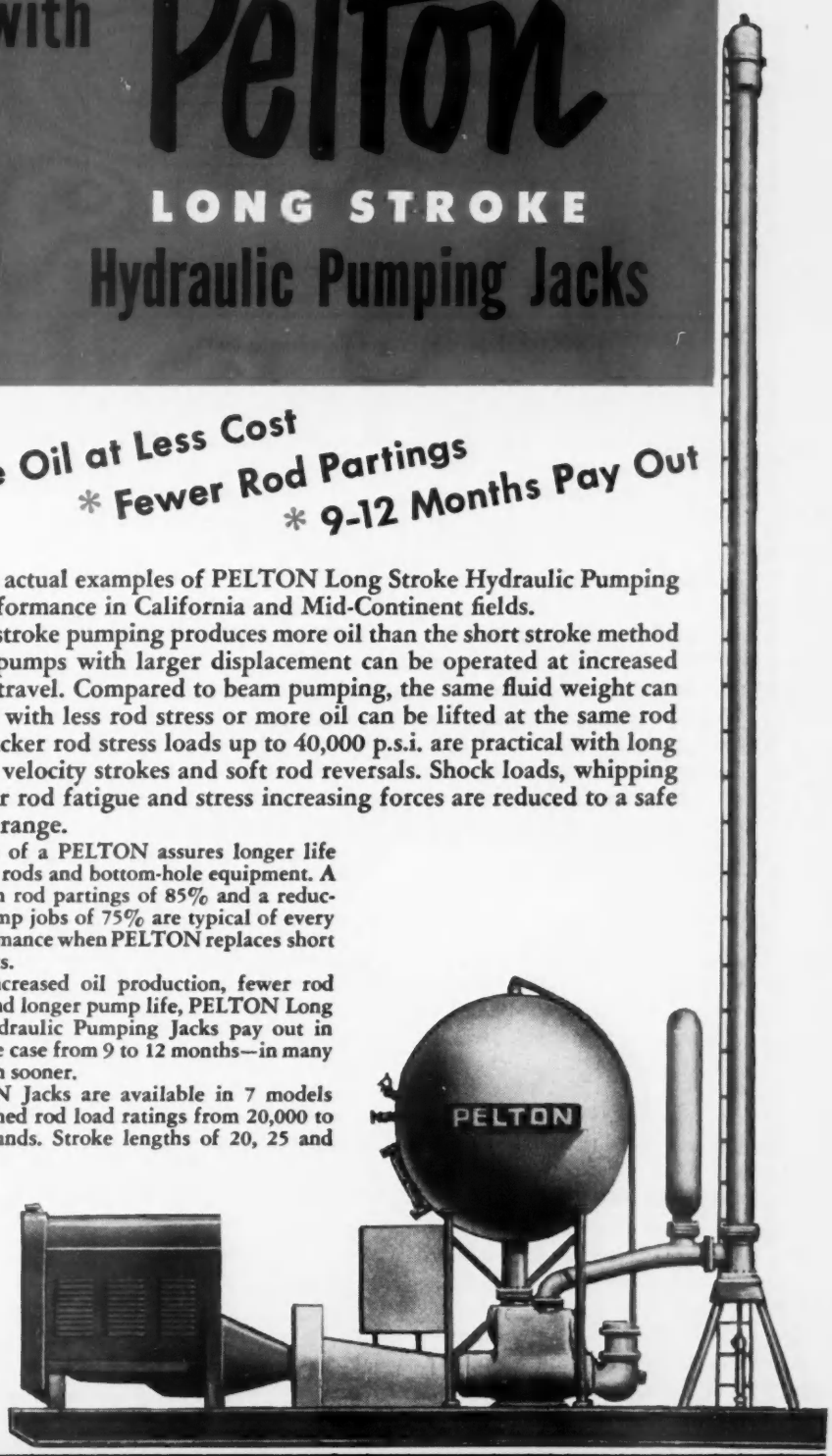

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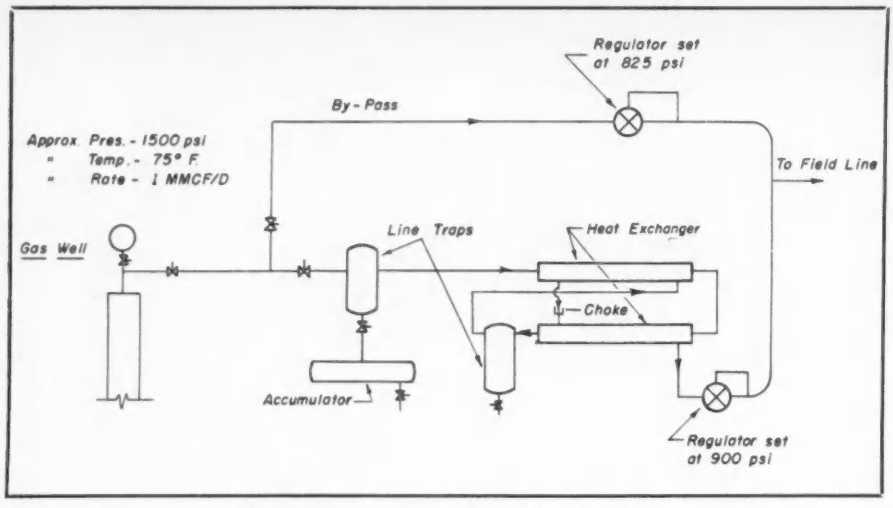

FIGURE 6. Experimental gas dehydration unit.

operating temperature. Liquids from the two traps were dumped automatically.

To obtain optimum results from traps, it is desirable that the pressure be as high as feasible and that the temperature be at, or near, the hydrate-formation temperature in the line trap.

If no excessive turbulence is expected, past experience has indicated that the gas temperature at the trap may be permitted to be about 10° F. below the hydrate point. There may be exceptions to the latter statement where gas pressures are higher than some 2500 psi. Gas at high pressure apparently freezes at temperatures closer to the hydrate point than does gas at moderate pressures.

It is good practice to avoid excessive turbulence at all points in the gas system, both upstream and downstream from the line trap. It is often necessary to heat the gas which has been processed by the trap, if the gas must undergo an appreciable reduction in pressure, such as that occurring in a choke or regulator.

Wherever possible, sags and risers in the flow line should be avoided. Field experience shows that the existence of such spots is conducive to freezing.

There is some uncertainty as to the effect of the amount of liquid water in a gas on its tendency to form hydrates. Although there is no obvious theoretical reason to account for it, it is indicated by some field experience that the more liquid there is in a gas, the more likely it is to freeze under low temperature and high pressure. Regardless of whether this is true or not, it is still good practice to remove as much liquid water as possible in order that, if freezing does occur, the severity of the freeze will be minimized.

After studying the individual problem, it is apparent that an operator can adapt practices and use auxiliary equipment to aid in obtaining the optimum from line traps. In some cases, wells can be flowed intermittently at a higher rate to make use of higher natural temperatures in the system. Where pressure conditions permit, wells can be partially choked ahead of the trap so as to use the cooling effect of the expanding gas to obtain optimum temperatures in the trap. Heat exchangers can be used, as and where needed, to heat or cool the gas. In some instances, heaters located downstream from the trap, but ahead of the meters and regulator stations, are needed to prevent freezing at these points of turbulence.

In one of the more recent types of automatic line traps, the gas-liquid mixture enters the upper chamber and is separated. The liquid flows to the lower chamber where it is separated into water and liquid hydrocarbons, so that the water can be bled and the liquid hydrocarbons can be returned to the gas stream either immediately or downstream from the regulator or meter stations. This particular device uses a highly sensitive means for bleeding the accumulated water. The same device is adaptable for use in removing all liquids that accumulate in the lower chamber. This type of device also lends itself to an operation in which the water is removed ahead of the conventional gas-oil separator and permits the operation of the gas-oil separator at very low temperatures so as to obtain gas-oil separations at lower temperatures.

The principal use of line traps is to remove the liquid water, but they can also be used to reduce the amount of water vapor so as to obtain an undersaturated condition of the gas downstream.

Wet-Type Dehydrators

Until recently, practically all wet-type dehydrators were installed in conjunction with gasoline plants or in central locations where a relatively large volume of gathered gas is processed. Table 2 shows some of the earlier wet-type plants installed and the operating conditions and results obtained. About a year ago, one manufacturer adapted the principles used in these plants to the manufacture and operation of lower-capacity units to handle smaller volumes,[2] with the result that an increasing number of wet-type dehydrators are being installed.

Figure 7 is a diagrammatic sketch showing the method of operating a typical wet-type dehydrator. Figure 8 is a photograph of such a plant that processes 20 to 25 Mmcf per day. The gas to be dehydrated is passed through the diethylene glycol or other liquid absorbents in the absorption tower. Diethylene glycol is continuously circulated through a heater and a tower to drive off the water and any absorbed gases. The design of this type of dehydrator can be varied in a wide range and still obtain good results. It is desirable that the temperature of the gas to be dehydrated be as low as possible, and the best all-around operating temperature is about 75° F. The absorber pressure is a variable that affects the results obtained, and the optimum pressure is about 700 to 800 psi when diethylene glycol is used, and about 1000 psi when triethylene glycol is used. At lower operating pressures, such as about 250 psi, the water content of the treated gas is approximately 2½ times that obtained at 750 psi, assuming all other variables are kept constant. In-

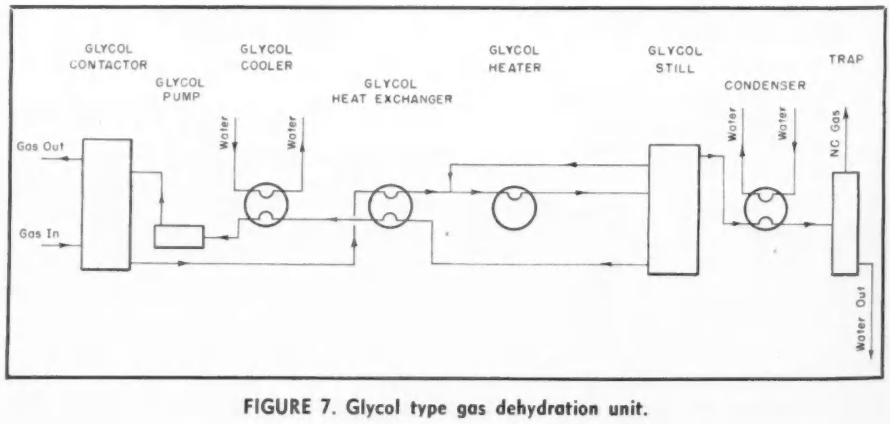

FIGURE 7. Glycol type gas dehydration unit.

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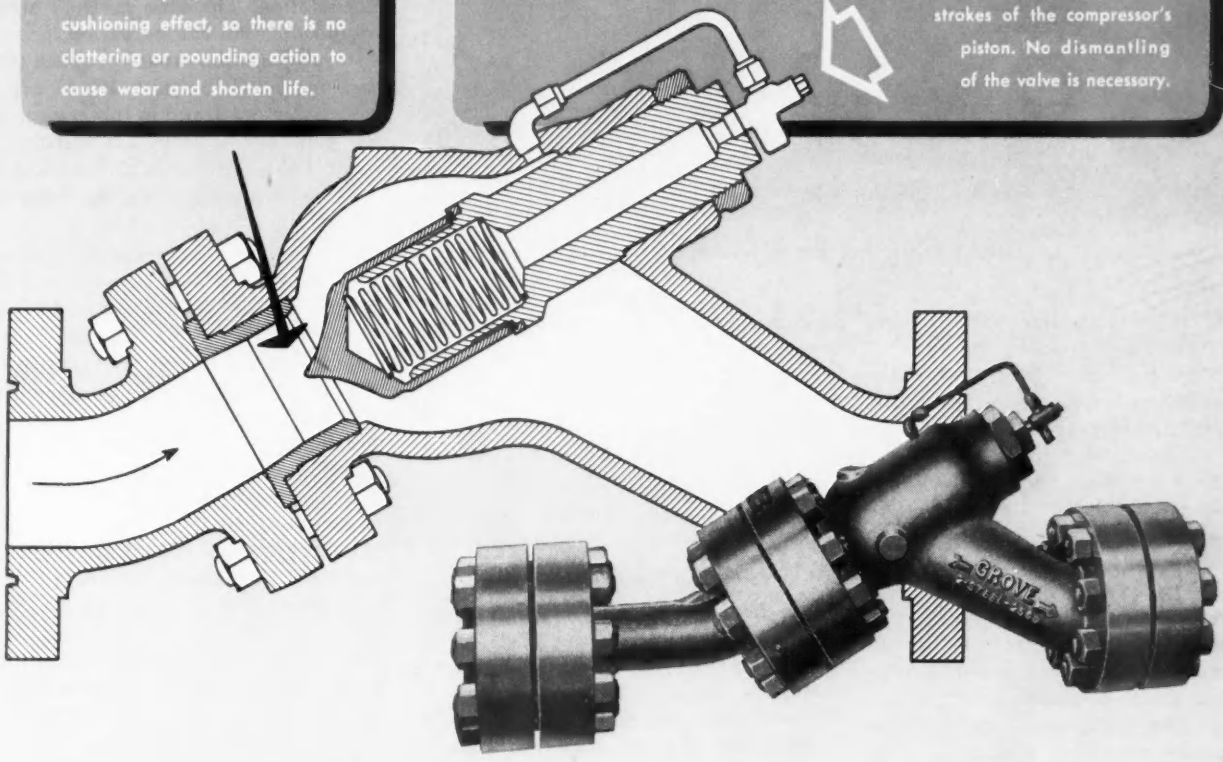

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FIGURE 8. Wet type gas dehydrator.

creasing the pressure above the optimum does not appreciably reduce the amount of water in the dehydrated gas. Little work has been done to indicate the maximum pressure that is feasible in wet-type dehydrators, but it is probably above 1500 psi. The rate at which the absorbent is circulated is another variable that affects results, and the circulating rate usually used varies from about 100 to 200 gallons per million cubic feet. The average dew point lowering that is obtainable in present plants is 40° to 50° F.; however, it has been noted that in individual cases, a better result is obtainable. The circulating rate and the heating facilities used should be such that the glycol in the absorbent contains as little water as possible, i.e., it should contain not more than about 2 percent water, even though many plants operate satisfactorily with as much as 5 percent water.

Heaters used in these plants have been the indirect type, i.e., steam or Dowtherm baths which provide temperatures in a range from 300° to 450° F. Direct heaters, some of which have the still mounted on top, appear satisfactory and are being used more widely.

The installed cost of wet-type plants has been fairly high, particularly in the larger plants. Recent developments indicate that triethylene glycol is a much better absorbent than diethylene glycol for this use.[3] It is likely that by using triethylene glycol present plants using diethylene glycol can be improved considerably, and new installations made in the future will be somewhat less expensive due to the use of a better absorbent.

Wet-type dehydrators used in the past have done an acceptable job using diethylene glycol, and with improvement, it is possible that they could satisfy a large part of the requirements where the use of traps does not give low enough dew points or where extremely low dew points are unnecessary. Besides the use of better absorbents, current development work on absorber design and on still design should result in better operation and higher capacities at lower installation costs.

Dry-Bed Type Dehydrator

Dry-bed type dehydrators have been adapted in the last several years to the oil-field problem. The method used, which is shown diagrammatically in Figure 9, consists of passing gas to be dehydrated through a bed of mineral that has the capacity to absorb the water vapor present until the mineral has absorbed an amount of water equal to about 5 percent of its weight. Two absorption towers are used, and while one is in operation, the other is being regenerated. Regeneration is accomplished by heating a small volume of gas taken from the main stream, passing it through the tower, and then through a heat exchanger and separator to remove liquid water. The gas that was used for regeneration is then recombined ahead of the absorption tower in operation as the dehydrator. Fluorite, activated alumina, and silica gel have been used as drying agents. Activated alumina has given slightly better results in regard to capacity, but fluorite apparently withstands attrition better. Neither is satisfactory for use where gas temperatures are above 100° F. In such cases, silica gel in the form of beads is recommended, and it appears possible to allow this mineral to absorb about 7.5 percent water before regeneration. The time cycle of absorbers in operation can be varied, provided it stays within the capacity of each tower. Dew points as low as —10° F. are frequently obtained, and in this regard, dry-bed type dehydrators are outstanding. Table 2 shows some of the dry-bed type units in use, the operating conditions, and the results obtained.

Figure 10 is a photograph of dry-bed type unit operating at a compressor plant to handle gas which originated as low-pressure lease gas that is gathered and compressed to 950 psi. The temperature of the gas leaving the compressors is 220° F., and to reduce this to a reasonable temperature, a radiator-fan type gas cooler is used. This results in a gas temperature varying from about 90° to 110° F. It was found that, when the gas temperature was 110° F., 6.5 Mmcf per day could not be properly dehydrated in the unit which had a rated capacity of 10 Mmcf per day at 70° F. The activated alumina bed was replaced with silica gel beads. When treating 6.5 Mmcf per day at 95° to 100° F., a —10° F. dew-point gas is obtained by the use of this silica gel bed.

The installed cost of dry-bed type units is about the same or slightly higher than the wet-type dehydrator using diethylene glycol as the absorbent. Dry-bed type units lend themselves readily to design for pressures up to 2000 psi and higher. These units have not been in service long enough to obtain accurate operating costs; however, it should be approximately .001 to .002 cent per thousand

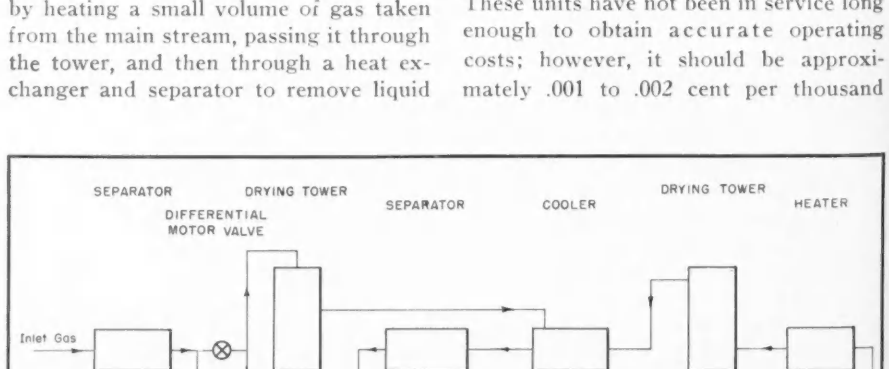

FIGURE 9. Solid desiccant type dehydration unit.

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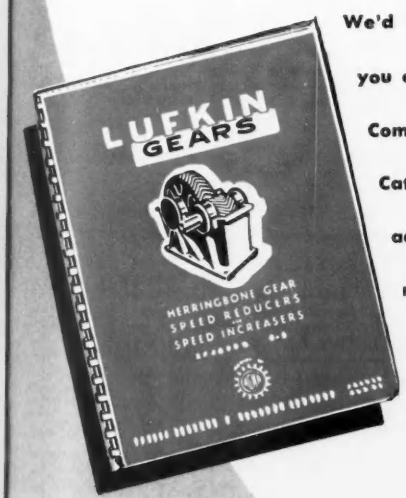

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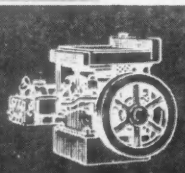
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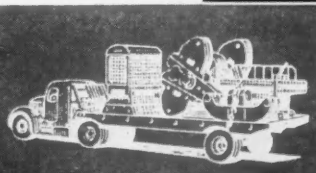
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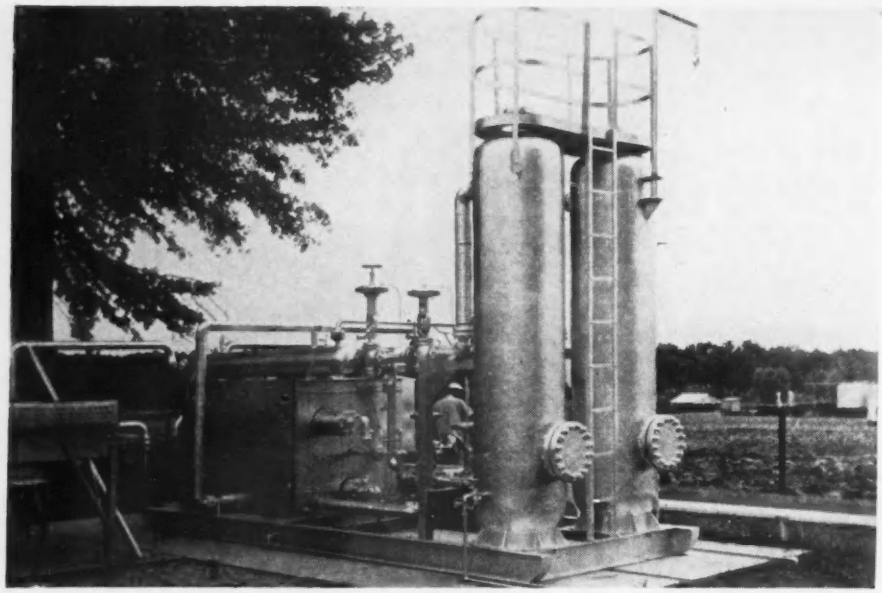

FIGURE 10. Dry bed type gas dehydrator.

cubic feet, which includes replacement cost of mineral and the fuel consumed for regeneration. The mineral life will vary with conditions, but it should be from one to four years, provided the mineral is not abused.

Dry-bed type units have reached a high level of development, but it is thought that continued study and development are desirable to reduce the installed cost of this equipment and to improve the results obtained. One such recent development is a radial-flow type absorber tower[4] which has an advantage over a conventional down-flow tower, in that any liquids entering the dehydrator can be removed before they have a harmful effect on the bed. Better dehydration and easier regeneration should be possible, as well as reducing the pressure drops through the mineral. The use of horizontal absorbers has not been adequately investigated. Some additional study is desirable to improve the heating and cooling procedures during regeneration. Faster heating, for example, may be the answer to the problem of exposing the mineral to liquid water during the regeneration cycle.

Combination Units

In some instances, combination units may have advantages. For example, if a dry-bed type unit is installed and the volume of gas to be dehydrated exceeds the capacity of the installation, some of the gas can by-pass the dehydration plant, if liquid water is removed, and be recombined with dehydrated gas, provided that the dew point of the dehydrated gas is low enough to have adequate water-carrying capacity.

A recent installation of probable interest is an operation in an East Texas field. The production from each condensate well is passed through a combination water-knockout gas-oil separator so as to divide the stream into water, liquid hydrocarbons, and gas. The gas, after metering, is dehydrated for transmission through a pipe line eight miles long. The liquid hydrocarbons from the separator are recombined downstream of the gas dehydrator and accompany the gas to a gasoline plant located in the second field. This system was selected after considerable study. In view of the fact that the operating conditions of the pipe line indicated that hydrate formations should be expected, the three-phase separation ahead of the dehydrator was selected to eliminate the necessity for pumping the oil back into the line if the water and oil were bled together and dehydrated to pipe line oil.

The knowledge gained in the gas-dehydrating art is being carried into the oil-treating and gas-oil separation arts. In some cases, it is feasible to remove water in traps operating at well pressures and then carry out gas-oil separation at low temperature. The low-temperature separations increase the relative volume of liquid hydrocarbons recovered. Usually, the liquid in the bottom of the separator must be heated to insure proper functioning of liquid dump valves on the separator.

Conclusion

Each of the three general methods of dehydration discussed has advantages and disadvantages, and each is applicable to certain problems. The line trap has the advantage of simplicity, and low installation and operating costs, but it has a limited application. The wet-type dehydrator will usually be cheaper to install and operate than the dry-type unit; however, the wet-type unit may not reduce the water content sufficiently to meet all sales contracts. The dry-type dehydrator is highest in cost, but can obtain the lowest water content. There is a need for considerable further study so as to provide better methods of dehydrating gas, as well as to develop better designs of equipment to utilize the present methods. Each dehydration problem should be studied carefully before selecting a method and equipment. The major factors that must be taken into account are volumes, pressures, temperatures, and the dew points required in view of the local temperature conditions or requirements imposed by gas purchasers, if the gas is sold.

ACKNOWLEDGMENT

The kind permission of the Humble Oil & Refining Company to publish this paper is appreciated.

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TABLE 2

Dehydration Plants

Drying Agent Used	Rated Working Pressure (PSI)	Rated Capacity (MMCF per Day)	Operating Pressure (PSI)	Volume Processed (MMCF per Day)	Average Operating Temp. (Deg. F.)	Average Dew Point Obtained (Deg. F.)	Water Content of Treated Gas (Lb. per MMCF)	Installed Cost
Diethylene glycol	900	100	830	50.0	94	24	6.0	$116,827
Diethylene glycol	1200	12	960	11.0	93	34	8.0	26,550
Diethylene glycol	1500	20	805	22.0	80	12	3.6	55,021
Diethylene glycol	1000	*50	740	46.0	77	34	9.5	96,399
Fluorite	1500	10	1000	4.4	100	13	3.3	33,764
Fluorite	840	20	750	5.0	90	—5	1.9	39,642
Fluorite	1500	30	1100	22.0	85	16	3.4	47,264
Fluorite	500	20	350	8.0	95	8	6.4	48,002
Fluorite	800	33	750	7.0	85	15	4.4	49,914
Activated Alumina	1500	15	900	12.0	96	Not yet Determined	....	38,387
Activated Alumina	800	50	800	15.0	100	—10	1.4	70,000
Silica Gel Beads	1000	10	950	6.2	98	—10	1.3	30,100

* This plant is designed so that its capacity can be increased to 100 MMCF by an estimated additional investment of $30,000.

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By MARVIN A. REMKE
Petroleum Engineer, Phillips Petroleum Company

WHETHER IT IS large or small, an oil field should be produced in a manner to recover the maximum quantity of hydrocarbons in place. Every reservoir should be studied in respect to its performance and means for prolonging its productive life. Small reservoirs should be given as much attention as larger reservoirs. In the aggregate there are considerably more smaller than larger pools. By applying advanced production techniques to such small pools the industry can be assured of increased yield, and valuable experience can be obtained in reservoir behavior and production techniques. This article was revised for WORLD OIL from a paper delivered before the North Texas Oil and Gas Association at Wichita Falls.

SUCCESSFUL repressuring by gas in the Larimore pool of Young County in North Central Texas is not a spectacular operation but production engineers, by studying the area and reservoir performance subsequent to the initiation of gas repressuring operations, may apply the same technique successfully in other fields possessing the same characteristics as found at Larimore.

The Larimore pool is about eight miles south of Olney, Texas, on Highway 251. It was discovered in April, 1930, with the completion of the E. I. Remington 1. Development was rapid due to initial potentials of about 800 barrels per day from the comparatively shallow Larimore sand. The pool was completely developed by the end of 1932. There was sufficient pressure initially to flow the wells, but the pressure declined rapidly and by the latter part of 1932 most of the wells were on the pump.

Cable tool spudders were used to drill the wells, which were on a 2½-acre spacing pattern. The final well density was about one well to three acres. In general, two water strings of casing were set at approximately 250 and 500 feet which were later recovered. Most of the wells are completed with 6⅝-inch oil string, although 8¼-inch and 5-3/16-inch oil strings were used in a few holes. It was customary to cement the oil string with ten sacks of cement. Total original cost of completing wells in this field was approximately $2500.

There are two producing sands, the Taach found at approximately 650 feet and the Larimore at approximately 700 feet. Geologically, these two sands are of the Cisco group, Pennsylvanian age, and occur immediately below the better known Gunsite limestone. From a production standpoint the Taach is relatively unimportant. The Larimore sand, under consideration in this article, is the most important reservoir within the immediate area.

The equipment first placed in service to return gas to the Larimore reservoir included two small compressors having an average capacity of about 50 mcf per day each and one compressor with a capacity of about 400 mcf per day. The West compressor on the Larimore lease was a 6 x 2⅞ x 6-inch two-stage compressor operating on the low stage only, powered by the West Larimore power engine. The Graham compressor was a 6 x 6-inch single stage compressor powered by the Graham lease power engine. The East Larimore compressor station located near the East power on the Larimore leases consisted of a 50-horsepower direct driven engine and compressor with 11 x 15-inch power cylinder and 11½ x 15-inch compressor cylinder.

Production History, Reservoir Performance

According to available records, repressuring operations were started early in 1931 before the pool was completely developed. Although there is no conclusive proof of the results obtained from this early repressure project, there are indications that it was successful from the beginning. Production for 1931, the first full year of operation, was about 327,000 barrels. It appears that initial repressuring operations were expanded in 1933 to retard the production decline as shown in Figure 1. In 1934 and 1935 the production remained fairly constant averaging about 190,000 barrels each year. Gas injection volumes and produced gas volumes were not available prior to 1942. In 1942 the injection volume averaged about 320 mcf per day which, in all probability, was close to the normal injection volume prior to 1942. Gas-oil ratio averaged 1900 cubic feet per barrel in 1942, increasing gradually to about 4800 cubic feet per barrel at the present time.

Several revisions were made in operating practices in 1942. Two of the six core tests drilled that year were utilized for injection purposes. At that time it was customary for the operator in charge to maintain back pressures of one to ten pounds on the casinghead of the most prolific wells. It was thought that this procedure would eliminate the bypassing of gas to these better wells. Without definite tests it was believed that these wells were producing excessive volumes of gas, but upon testing, it was concluded that the gas-oil ratios in the order of 2300 cubic feet per barrel were not excessive, since average gas-oil ratio for the project during 1942 was about 1900 cubic feet per barrel. After a thorough review of the performance of the reservoir the casinghead back-pressure was eliminated and in so doing the gas volume through the compressors was increased.

As will be seen on the production performance curves (Figure 1) the input volume during the latter part of 1942 was about 300 mcf per day. This injection volume was increased to 420 mcf per day by the middle of 1943 and

530 mcf per day during the latter part of 1944. By increasing the injection volume in this manner and eliminating the casinghead pressures at the producing wells, an increase in production was immediately realized and was maintained for the next two years. Production from the latter part of 1942 to the latter part of 1943 increased from 170 to 210 barrels per day. The latter figure, if projected above the normal decline established before 1942, represented a 50 percent increase, and indicated what might be accomplished by increasing gas injection into the reservoir. Since 1944 production gradually declined due to the fact that the 50 hp compressor was continually loaded causing considerable shutdown time. It was difficult, indeed practically impossible, to maintain the desired injection volumes with the limited equipment capacity.

Repressuring Intensified

Recognizing the advantages of increased gas injection, an additional compressor was installed at the East Larimore compressor site during the last quarter of 1948. In addition, seven new producing wells were drilled to fill in the entire drainage pattern in the reservoir, particularly in the south central portion of the Larimore lease and the north central portion of the Graham lease. As a result of the study for intensified gas injection, a number of shutdown wells were converted to producers. Four wells were converted to injection wells and one new injection well was drilled. While no definite results are yet available from this intensified repressuring program, there is some indication of increased production.

In order to increase the gas capacity for injection to the reservoir a 100-hp direct driven compressor having a capacity of 800 mcf per day and 40 pounds injection pressure was placed in operation during November, 1948. The use of the smaller compressors has been discontinued except to maintain the 50-hp compressor as standby service. With the 800 mcf per day compressor capacity it is believed possible to retard the decline in production. By purchasing some make-up gas to augment the supply of gas produced it is expected to maintain injection rates at around 600 to 700 mcf per day and increased production is anticipated.

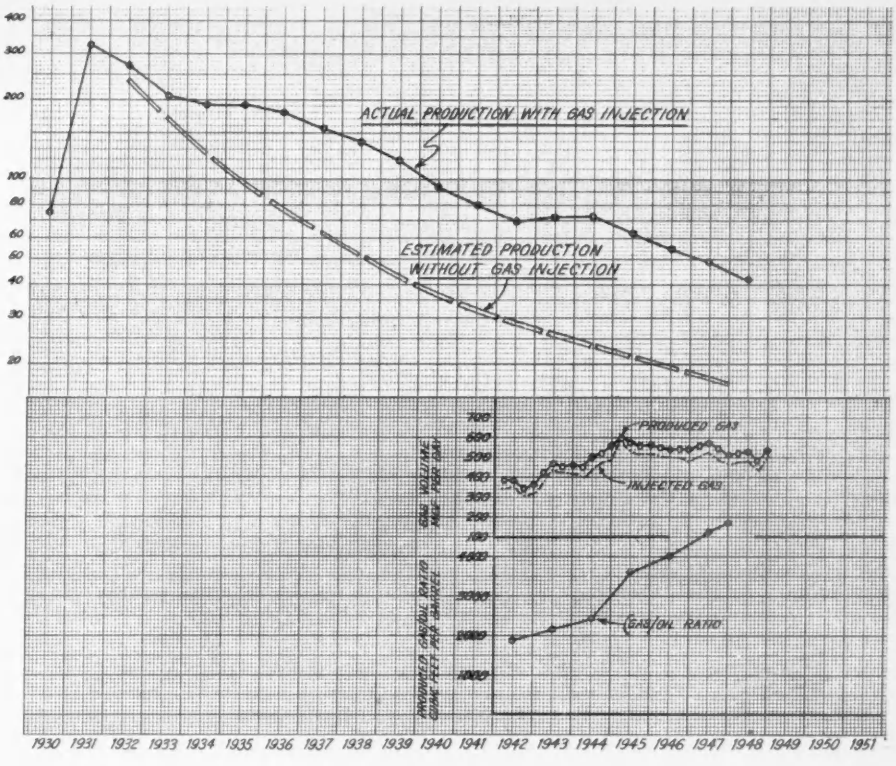

ACTUAL PRODUCTION WITH GAS INJECTION
ESTIMATED PRODUCTION WITHOUT GAS INJECTION
PRODUCED GAS
INJECTED GAS
GAS/OIL RATIO
1930 1931 1932 1933 1934 1935 1936 1937 1938 1939 1940 1941 1942 1943 1944 1945 1946 1947 1948 1949 1950 1951

FIGURE 1. Reservoir performance and production history, Larimore Repressure project, Young County, Texas.

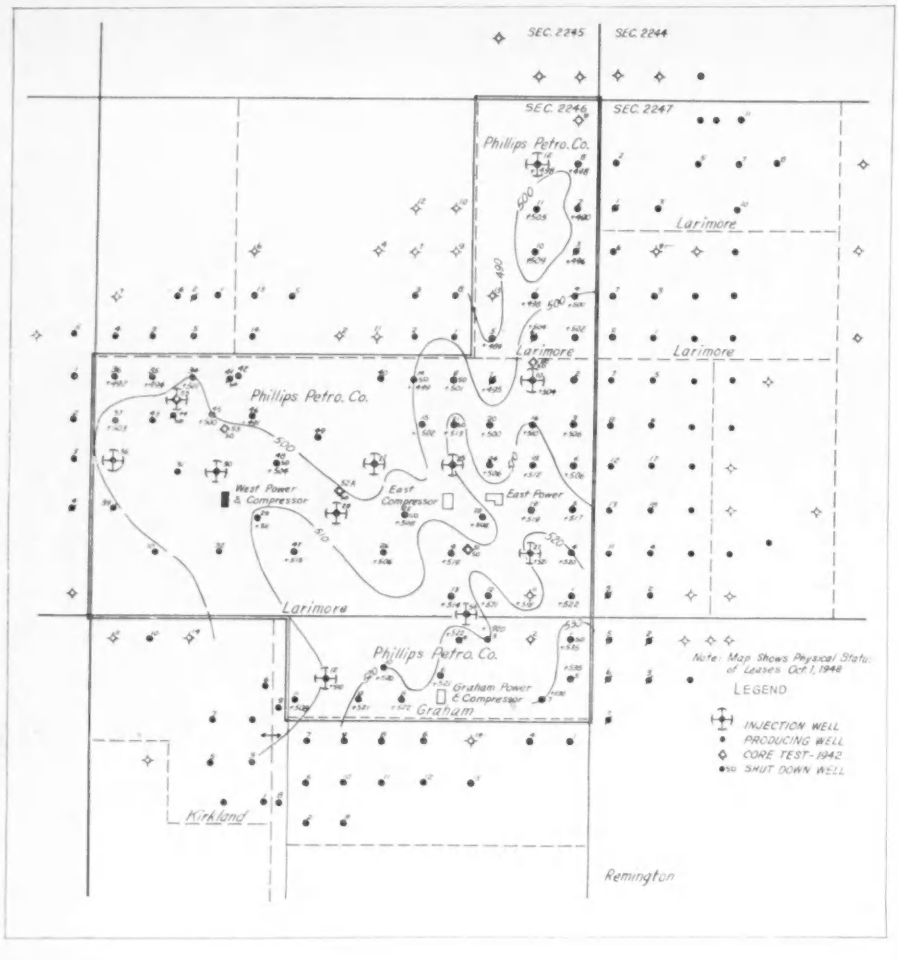
Reservoir Characteristics

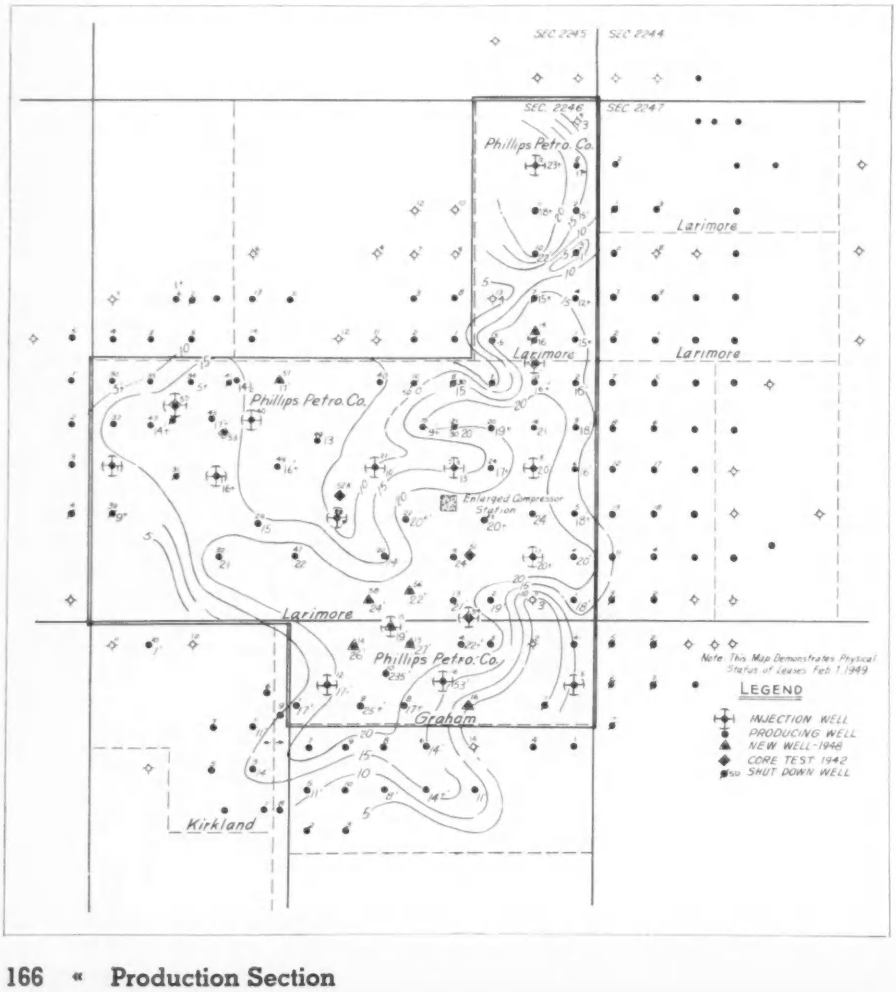
The Larimore sand pool is on a monocline dipping gently to the northwest with its longitudinal axis roughly parallel to the strike of the monocline (Figure 2). The Isopach map of the productive Larimore sand (Figure 3) indicates the lenticular nature of the reservoir. No cores were originally available to analyze the lithological characteristics of the sand body. In 1942 a study was made to determine the advisability of water flooding the pool. Six core holes were drilled at selected locations shown on Figure 3 and analyses showed the sand highly permeable and porous and containing 23 percent connate water. Four core tests were drilled using water-base mud as drilling fluid and two core tests using oil as drilling fluid in order to determine if possible the saturation of the Larimore sand reservoir. Average permeability of the sand is more than 1000 millidarcys, ranging from less than one millidarcy to as high as 4200. The average porosity is in the order of 25 percent. The main sand body is fairly homogeneous with respect to its vertical limit and the average thickness underlying the 200 acres included within the repressured area is about 16 feet.

Upon drilling the core tests in 1942 (11 years after the field was discovered) it was found that gravity drainage, or gas and oil segregation, existed in the reservoir. The gas sand showed 11 percent oil saturation and the oil sand 24 percent. These saturations were determined from cores taken in water-base mud and it is naturally expected that considerable flushing occurred, particularly in the lower oil saturated section of the sand. It is believed that the oil sand zone was saturated in the order of 58 percent at the time the cores were obtained. It was apparent from the flushing action indicated by the above percentages of saturation that gas repressuring has been very effective. The

About the Author

MARVIN A. REMKE was graduated from the University of Colorado in 1939 with a B.S. degree in mechanical engineering and then joined The Carter Oil Company as an engineering trainee. He worked from the roustabout gang up to the main office and the laboratory. Between 1940 and 1944 he was in Illinois as a senior petroleum engineer handling drilling and production problems and in the Tulsa office, where he did appraisal and valuation work in the Economics department. He joined Phillips Petroleum Company in 1947 and is now division reservoir engineer, Central division, Oklahoma City.





continuance of gas repressuring was, therefore, believed advisable.

There was considerable doubt regarding the effectiveness of water flooding this highly permeable sand due to the mechanical difficulties anticipated in injecting the water at the desired point in the sand profile. Injecting water into the oil zone and moving the oil into the gas zone in all probability would result in the movement of the larger portion of the residual oil into the pore space of the gas zone, thereby resulting in loss of otherwise recoverable oil.

Estimated Oil Recovery

From a total recovery standpoint it appears that the Larimore sand reservoir has been unusually prolific. Accumulated oil production as of January 1, 1949, totaling about 2½ million barrels, represents total recovery of about 56½ percent of the total volumetrically calculated stock tank oil-in-place. Recognizing that volumetric calculations are not absolutely reliable due to the lack of definite reservoir data a reasonable estimate of the total stock tank oil in the reservoir underlying the repressured area is 4,350,000 barrels. A reasonable primary production decline is projected on the production history and performance curve (Figure 1). Total primary production is estimated to be about 1½ million barrels and represents 35 percent of the stock tank oil-in-place. In most cases the recovery factor of 25 percent would be expected for normal primary operations.

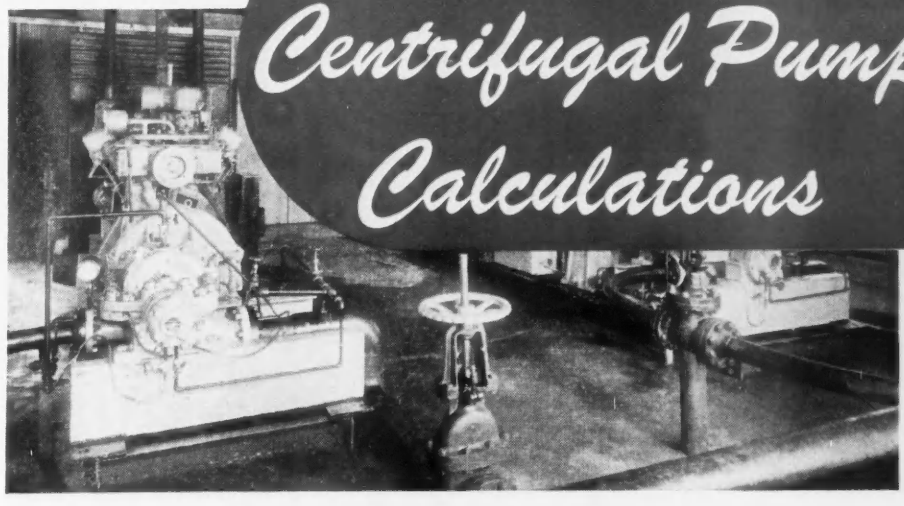
It is probable that the higher primary recovery factor as indicated above can be justified if consideration is given to the fact that the original fluid in the reservoir might have been undersaturated and if consideration is given to the fact that the permeability and porosity of this reservoir are unusually high. Reservoir conditions are, therefore, advantageous for better than average primary recoveries. Assuming the primary recovery to be correct the net oil recovered as of January 1, 1949, due to gas injection, is estimated to be 937,000 barrels, or 21½ percent of the stock tank oil-in-place. It is anticipated that with the intensified gas injection plan as outlined additional oil-in-place will be recovered.

FIGURE 2 (top). Contour structure map of top of Larimore sand.

FIGURE 3 (bottom). Isopach map of productive Larimore sand.

Engine-Driven Centrifugal Pump Calculations

By TYLER G. HICKS
Mechanical Engineer



TWO OF the most important problems in engine-driven centrifugal pumps are those of performance variation with engine speed change, and estimation of operating costs. These problems are most frequently encountered during selection of a pumping unit or when applying an existing unit to a different type service. This article concisely presents the various factors, with a typical solution of a specific problem.

GAS, gasoline, and oil engines used for centrifugal pump drive differ from electric motors in one important aspect. Electric motors are constant speed units, whereas internal combustion engines are variable speed machines. When a motor is used for centrifugal pump drive, performance characteristics are easily predicted because pump speed can be assumed as constant. Internal combustion engine speed, however, varies with power output, regardless of fuel used. Assumption of constant speed over the rated range of the engine would lead to erroneous results and unsatisfactory operation in the field. Special calculations to determine actual performance are therefore necessary.

Figure 1-A shows a typical power-speed curve for a gas engine. As can be seen, power falls off rapidly as speed decreases. In Figure 1-B the performance curves for a centrifugal pump to be driven by this engine are given. The pump has a rated capacity of 800 gallons per minute at a 300-foot head when operating at 1750 revolutions per minute. A 100-horsepower electric motor or internal combustion engine driver has been recommended by the pump manufacturer for this unit. Before making a series of calculations to determine the effect of speed variation on pump characteristics, a specific instance will be considered in detail.

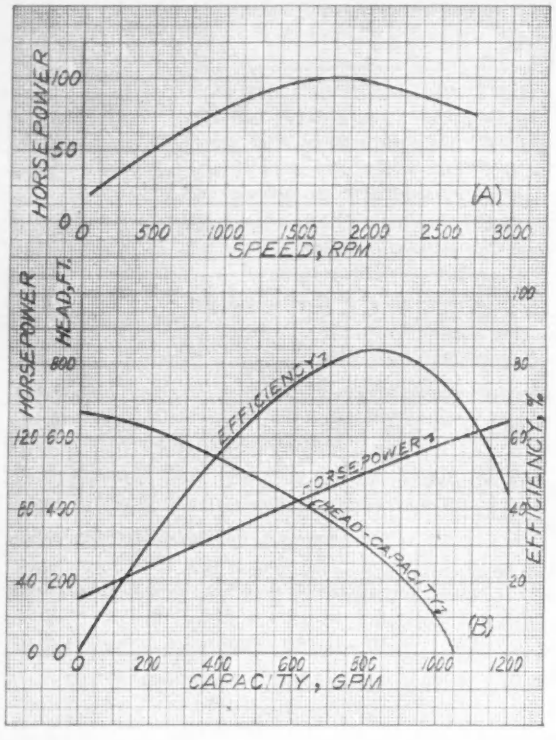
Speed Variation

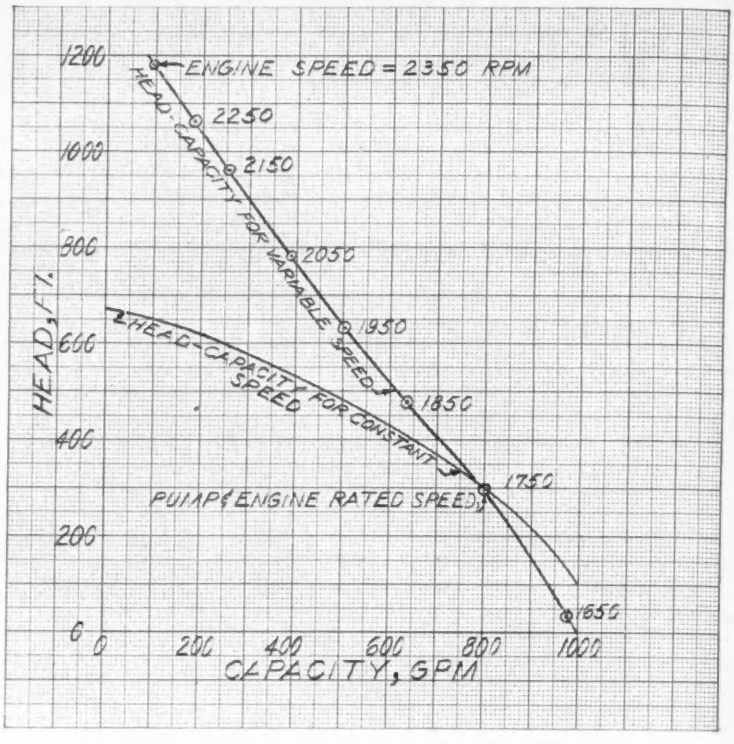
One of the laws which governs centrifugal pump operation is concerned with capacity (gallons per minute), head, and power input. When pump speed is changed, capacity varies in direct proportion, head varies as the square of the pump speed, and power as the cube. Figure 2 is a plot of this law. Thus, if pump speed were increased to 2050 rpm, or to 117.2 percent of rated speed, capacity would be 117.2 percent of normal, head 137.4 percent of normal, and power input about 161 percent, as shown. Referring back to Figure 1-B, it is seen that when the pump is handling 500 gpm at 1750 rpm, head is 485 feet; power input is 75 horsepower. With a 500 rpm increase in speed, capacity would be $1.172\ (500) = 586$ gpm, head $= 1.374\ (485) = 666$ feet, and power $= 1.61(75) = 120.8$ horsepower. Although pump efficiency changes slightly with speed, the difference is so small that it can be neglected during most practical calculations.

When a centrifugal pump is driven by an electric motor at constant speed, i.e. 0 percent speed variation, a change in head increases or decreases capacity and power input. Thus, in Figure 1-B, when pump head is reduced from 300 feet to 200 feet, capacity increases from 800 to 912 gpm and power from 100 to 110 hp. Increasing the head to 400 feet, while speed is kept constant, reduces capacity to 650 gpm and power input to 88 hp. The motor supplied by the pump manufacturer will handle these changes in

TABLE 1
Pump Operating Characteristics

a. Engine speed, rpm	1650	1750	1850	1950	2050	2150	2250	2350
b. Rated engine hp	99	100	99.5	99	95	92.5	90	87.5
c. Speed change from rated, rpm	−100	0	100	200	300	400	500	600
d. Percent of rated speed	94.3	100	105.8	111.5	117.2	123.0	128.6	134.2
e. Percent change of pump capacity	94.3	0	105.8	111.5	117.2	123.0	128.6	134.2
f. Percent change of head	89.0	0	111.6	124.2	137.4	151.0	165.2	180.4
g. Percent change of power	84.0	0	118.0	138.7	161.0	186.0	212.5	242.0
h. Allowable pump input power, hp	118	100	84	71.5	59	49.7	42.4	36.2
i. Allowable capacity, gpm, at rated engine speed	1035	800	600	450	330	205	140	70
j. Allowable head, feet, at rated engine speed	40	300	430	510	570	620	640	656
k. Allowable capacity at operating speed, gpm	975	800	634	505	387	252	180	94
l. Allowable head at operating speed, feet	35.6	300	480	634	784	960	1060	1183





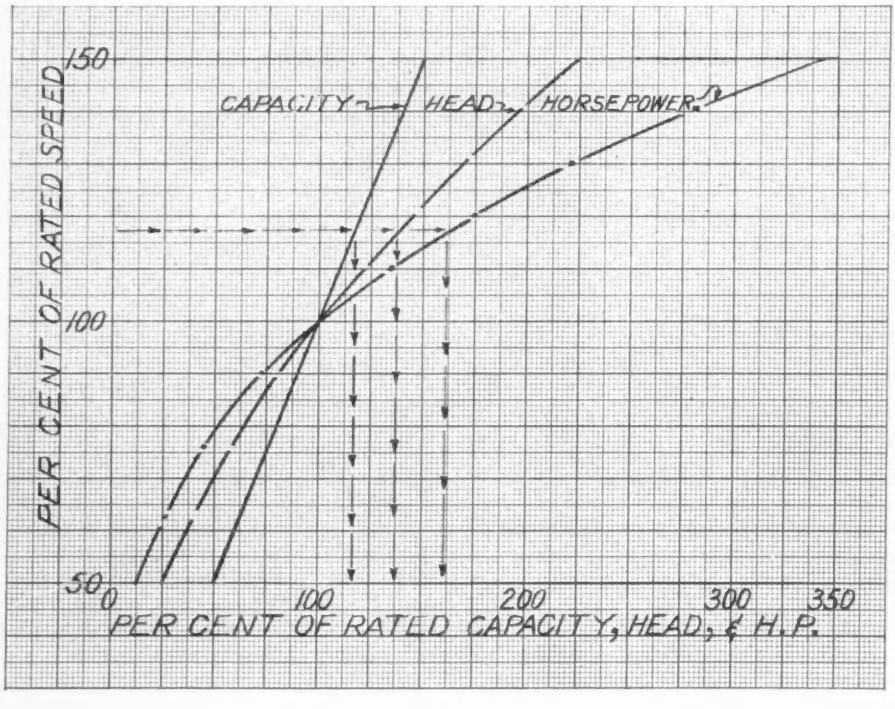


FIGURE 1 (top left). (A) Speed-power characteristics for a typical gas engine used to drive centrifugal pumps in oil fields. (B) Centrifugal pump characteristics in A and B are used in the example presented in the text of this article.

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FIGURE 2 (left). Plot of law governing centrifugal pump operation. To use, enter at the percent of rated speed and project horizontally to the proper curve. At the bottom read the percent of rated capacity, head, or horsepower which the pump will operate at when speed is increased or decreased to the value shown at the left.

•

FIGURE 3 (top right). Variable speed and constant speed characteristics for the engine-pump combination whose operating curves are shown in Figure 1. Calculations necessary to obtain the variable speed curve are explained in the text.

conditions without an appreciable rise or fall in speed.

An internal combustion engine used to drive this pump would not produce the same results as an electric motor because speed would vary with power output. Thus, reducing pump head to 200 feet would decrease engine speed because required pump input power is greater. According to Figure 1-A, engine power output would also decrease. The result of these two conditions, increased pump input power and decreased engine output power, is unit operation at some point other than that indicated by pump characteristic curves. Because pump power decreases more rapidly than engine power, the point of power equality is not too far below the rated engine speed. When pump head is increased to 400 feet, required pump input power decreases, engine speed increases, and pump power rises until there is an equality between the two again.

Capacity Calculations

This brief discussion serves to indicate the several factors ordinarily encountered in oil field applications of engine-driven centrifugal pumps. To determine the optimum capacity and operating speed for any given engine and pump, a series of calculations correlating pump speed and capacity must be made. This is done as follows:

Assume that a 1750 rpm, 100 horsepower gas engine has been selected to drive this pump. The two units will be directly connected by a coupling. Speed of the engine selected can be varied from about 1650 to 2350 rpm and it is desired to use full engine power for

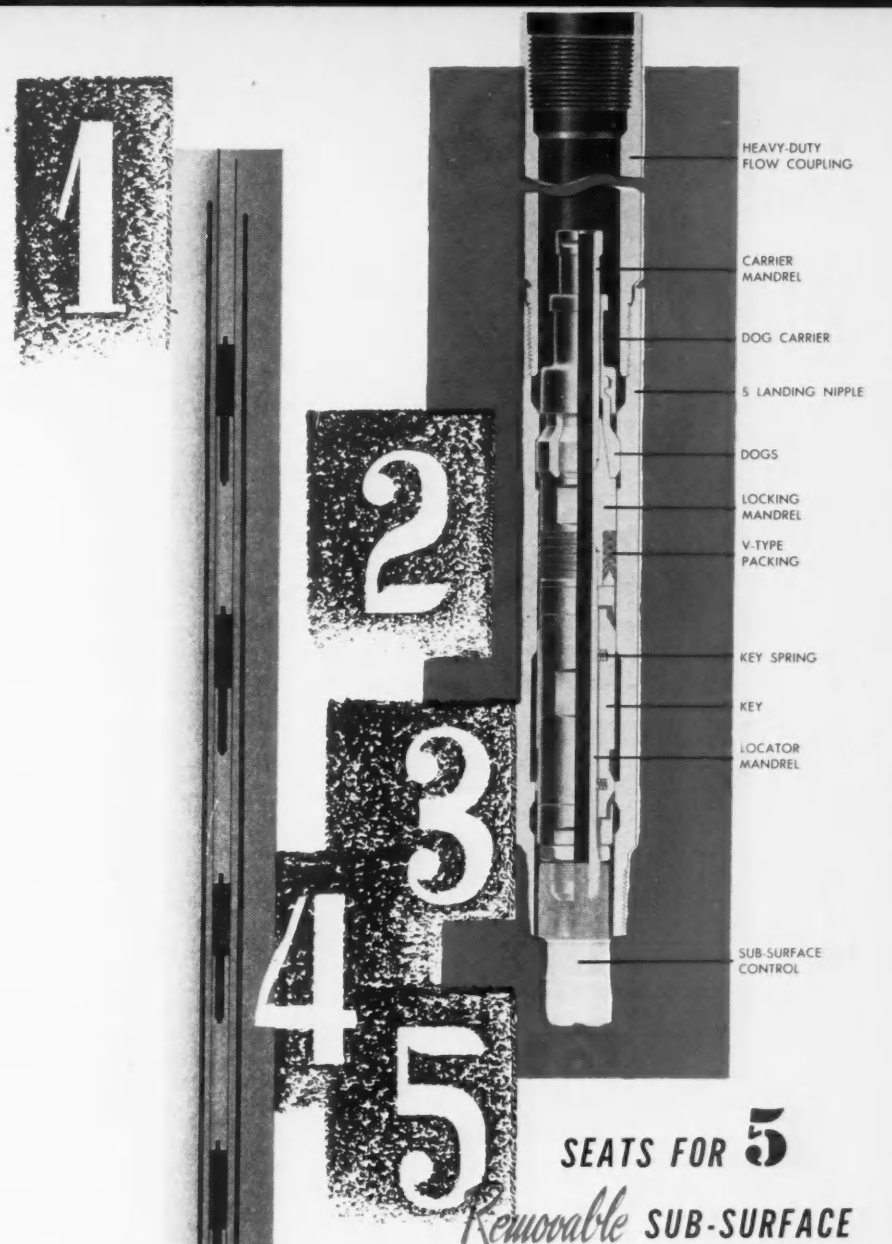
pumping at all speeds. Maximum pump capacity and head at every speed between 1650 and 2350 rpm must be known before the pump can be applied to any oil field service.

To simplify calculations, a form similar to Table 1 can be set up. A suitable speed increment, in this case 100 rpm, is selected and the various speeds listed. Rated engine horsepower as obtained from Figure 1-A is then entered for each speed selected. Next the percent of rated speed is listed and then the percent change in pump capacity, head, and horsepower, from Figure 2, are tabulated. Study of these data shows that when pump speed is increased to about 25 percent greater than normal, i.e. 2250 rpm, engine power would have to be 213 percent of normal. Since no commercial engine should operate at a high overload, the allowable input power to the pump will have to be determined and from that the pump performance at actual operating conditions.

Therefore, to find the allowable pump input power based on 1750 rpm for each speed, divide the engine horsepower by the percent change in pump power expressed as a decimal. Respective values are then entered for each speed. These input power values represent the maximum power which can be supplied the pump at 1750 rpm without overloading the engine when pump speed is changed to some higher or lower figure. Heads and capacities based on these inputs will be safe for the other speeds at which the pump may be operated.

Hence, read from Figure 1-B the head and capacity for each allowable input value listed in line **h** of Table 1 and enter them on lines **i** and **j**. These figures are for rated engine and pump speed, 1750 rpm. To obtain the capacity and head at the planned operating speeds, multiply each value in lines **i** and **j** by the percent change in capacity and head, respectively, expressed as a decimal. These values were obtained from Figure 2 and were entered in lines **e** and **f** of the table. Results are given in lines **k** and **l**.

A plot of allowable heads and capacities, Figure 3, shows the performance which can be expected from this pump at various speeds. As can be seen, by increasing engine speed a greater head may be pumped against but the capacity decreases as head goes up. The relation between head and capacity for this pump and engine combination is almost a linear function. To permit comparison between constant and variable speed operation of the pump, the head-capacity curve for 1750 rpm has also been shown in Figure 3. Study of the two curves shows that variable speed operation obtainable with internal combustion engine drive will produce higher heads, a feature which is often desirable in oil field work. Of course, variable speed electric



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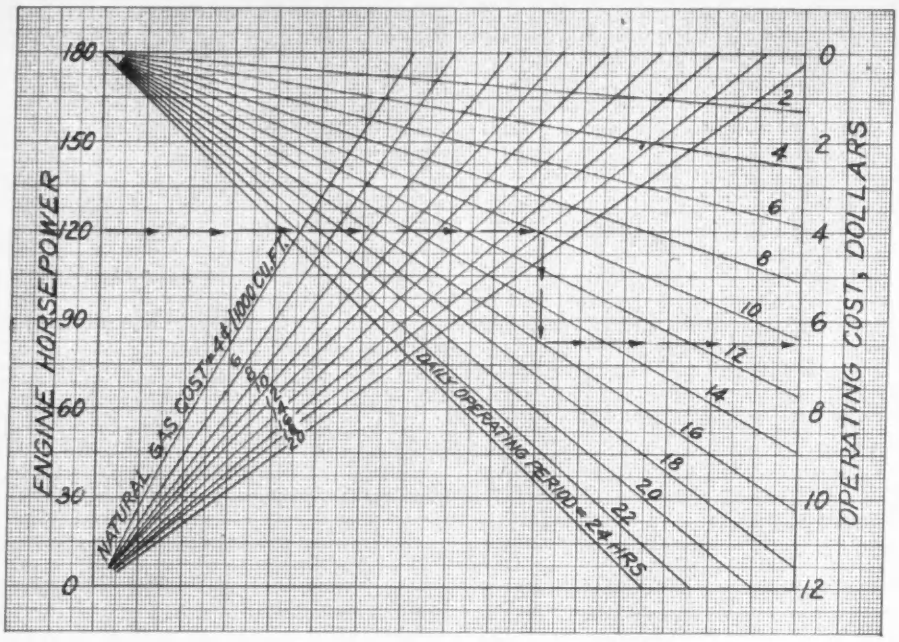

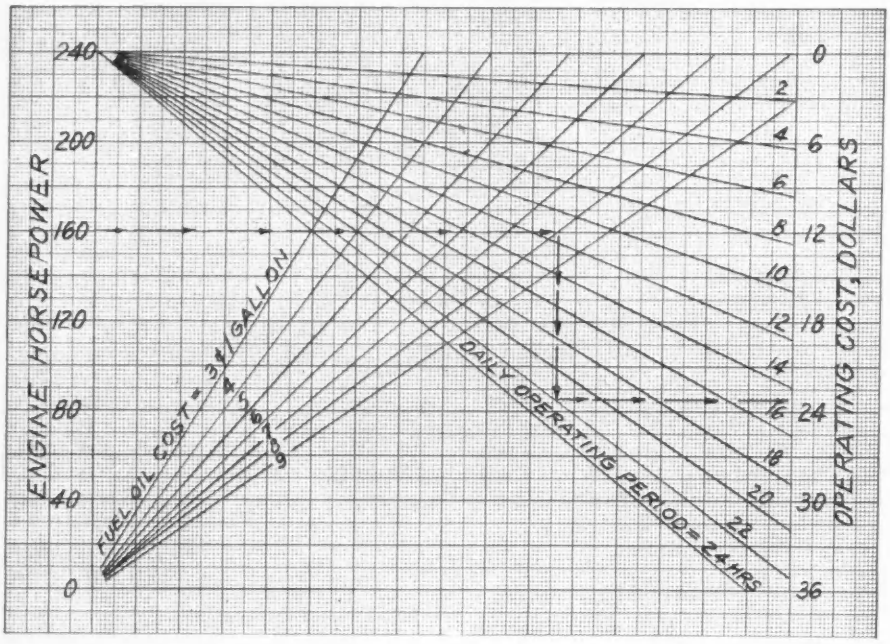

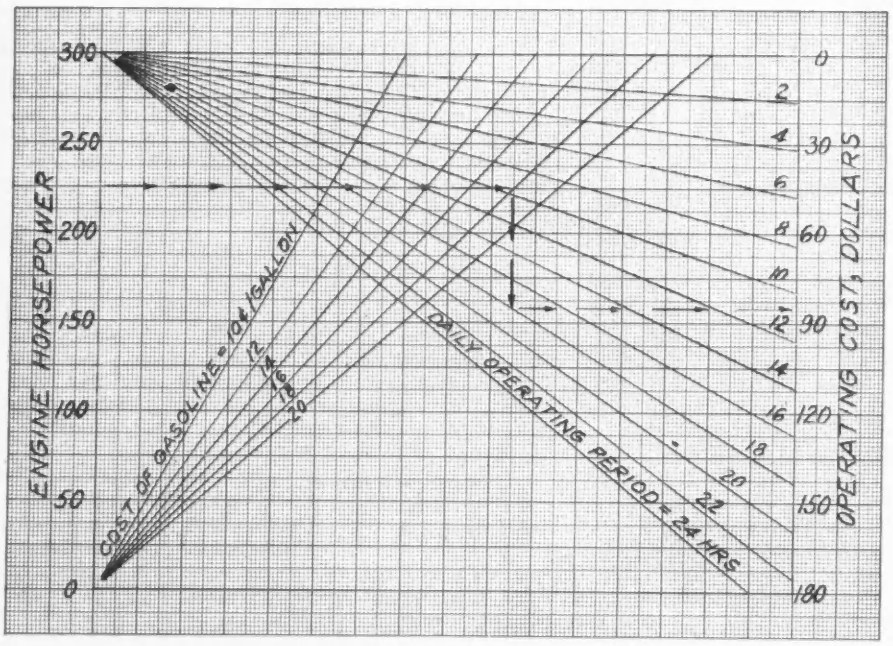

motors and controls are available for pump operation but a complete discussion of their operating characteristics cannot be undertaken here.

Operating Costs

Engine-driven pump operating characteristics can be predicted with good accuracy by the method given above. Exact estimation of operating costs is a little more difficult because fuel heat value, engine maintenance procedures, and operating methods vary widely from one field to another. However, the three charts, Figures 4, 5, and 6, permit rapid and fairly accurate estimates of gas, oil, and gasoline engine operating costs. These charts are based on full load operation of typical engines available at present and the fuel costs cover ranges normally encountered. Lubricating oil costs included are somewhat approximate but experience shows that they closely approach values found in most fields. Basing costs on continuous full load operation provides a factor of safety which prevents errors during estimates. Only when economic analyses must be accurate down to the last dollar need partial load fuel consumption be given serious thought.

Use of the charts is simple and is explained in Figure 4 cutline. With these three charts and the speed chart of Figure 2, it is possible to make a rather complete analysis of a proposed or existing pumping unit driven by an internal combustion engine. Engine and pump characteristic curves similar to those shown in Figures 1-A and 1-B can be obtained from manufacturers. In addition, details of engine performance which may affect pump operating characteristics are also available. These should be used whenever necessary in the analysis.

FIGURE 4 (top). Intersection chart for determining the daily operating cost of an internal combustion engine using natural gas fuel. To use, enter at the engine horsepower and project horizontally to the fuel cost curve. Then project vertically to the daily operating period in hours. From here run across to the right to read the daily operating cost for fuel and lubricating oil in dollars. Thus, with a 120 horsepower engine, 18-cent fuel, and 16 hours operating per day, fuel and lubricating oil cost is $6.50 per day. Chart is based on full load operation for the entire day.

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FIGURE 5 (center). Chart for finding operating cost of an internal combustion engine using oil fuel. Use of this chart is the same as Figure 4. Chart is based on continuous full load operation.

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FIGURE 6 (bottom). Chart for finding operating cost of an internal combustion engine using gasoline fuel. Use of this chart is the same as Figure 4. Chart is based on continuous full load operation.

Effect of Reservoir Rock on

Vapor-Liquid Equilibrium

By DR. CHARLES F. WEINAUG
Chairman, Department of Petroleum Engineering, University of Kansas

THE AUTHOR DISCUSSES the significance of vapor pressure changes in the production of condensate reservoirs and develops the theory that sand or reservoir rock in an actual field does not affect vapor-liquid equilibrium significantly.

TWO articles recently published are of significance in the production of condensate reservoirs: "Experiments on the Capillary Properties of Porous Solids" by Calhoun, Lewis, and Newman,[1] and "Revaporization of Butane and Pentane from Sand" by Weinaug and Cordell,[5] Calhoun et al, show that the vapor pressure of a liquid contained in a porous solid is lowered in the presence of the sand or porous media; while the other article indicates that the P-V-T vapor-liquid equilibrium values are not affected by sand.

If the vapor pressure of a liquid is lower when it is in a porous medium composed of consolidated sand grains, as in Calhoun's experiment, it would appear that the vapor-liquid equilibrium would also be affected in any other experiments of this type. It is the purpose of this report to discuss this apparent discrepancy and the significance of vapor pressure changes in the production of condensate reservoirs.

It has long been recognized that the vapor pressure above a curved surface is related to the vapor pressure of the liquid above a flat surface, the curvature of the liquid surface, and the surface tension. The smaller the radius of curvature, the greater is the difference in vapor pressures above the curved and flat surfaces. Also, a concave surface results in a lower vapor pressure, whereas a convex surface produces a higher vapor pressure. The change in vapor pressure is greater for liquids having a high surface tension. All these factors are mathematically related.

This relation (3) for a concave surface is:

Where p_∞ = vapor pressure over a flat surface
p = vapor pressure over a curved surface
γ = surface tension
r = radius of curvature
ρ = density of the liquid
M = molecular weight of the vapor
R = gas law constant
T = absolute temperature

$$\ln \frac{p_\infty}{p} = \frac{2\gamma}{r\rho} \frac{M}{RT}$$

The mathematical expression for a convex surface is:

$$\ln \frac{p}{p_\infty} = \frac{2\gamma}{r\rho} \frac{M}{RT}$$

These recognized relations are used to show that no real discrepancy exists in the data of Calhoun and Weinaug. The lowered vapor pressures were measured for liquids contained in a porous medium made up of consolidated sand grains whose average diameter was about one-third that of the sand grains used in the revaporization experiments of Weinaug. The smaller average grain diameter produces a porous medium with smaller capillaries which, in turn, cause the curvature radii of contained liquid surfaces to be smaller and results in a direct decrease in vapor pressure. This was further accentuated by deposition of silica from a colloidal suspension and by hydrolysis of tetraethyl orthosilicate within the pores of the sand. Thus, the reduction in vapor pressure in Calhoun's experiments is considerably more than would be expected under the conditions of the revaporization work of Weinaug and Cordell.

Calhoun[2] further indicated that the silica laid down during the consolidation process probably was in the form of silica gel. This material contains many extremely fine capillaries which further account for the differences observed, especially at low saturations.

The differences in physical properties of the fluids used in the two experiments also aid in explaining part of the decrease in vapor pressure which was observed in Calhoun's experiment. However, the effect caused by difference in physical properties is very small compared to the effect caused by different pore sizes.

Application to Actual Reservoir Conditions

Neither experiment discussed above duplicates all the actual reservoir conditions. In the experiments of Calhoun only water was used to form the liquid and vapor phases, while those of Weinaug and Cordell were performed only with hydrocarbons. However, the pores of an actual reservoir are considered to contain a liquid water phase (interstitial water) in addition to either a gas phase or a liquid hydrocarbon phase (oil), or

■ CONTINUED ON PAGE 180

About the Author

DR. CHARLES F. WEINAUG received his B.S. degree in Chemical Engineering in 1939 from the University of Michigan, continued his studies there and received an M.S.E. degree in 1940 and a Ph.D. in 1942, both in Chemical Engineering. From 1942 to 1946 he was a chemical engineer with Phillips Petroleum Company, doing research and development work. In 1946 he resigned and became an associate professor in the Petroleum Engineering department and research engineer in the Bureau of Engineering Research at the University of Texas. He remained there until 1948, when he became chairman of the Department of Petroleum Engineering at the University of Kansas.

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Chemical Analysis

	Pct
Carbon	0.32 to 0.40
Manganese	0.50 to 0.70
Phosphorus	0.04 max
Sulphur	0.05 max
Silicon	0.15 to 0.30
Nickel	0.50 to 0.80
Chromium	0.30 to 0.50
Molybdenum	0.06 to 0.12

Mechanical Properties

	Average	Minimum
Yield Point, psi	65,000	60,000
Tensile Strength, psi	95,000	88,000
Elongation in 2 in. on full section, pct	35	32
Reduction of Area, pct	60	50
Brinell Hardness Number	192	174
Izod Impact, ft lb	—	50

If you want long, economical service in low-sulphide wells, choose the Bethlehem "X" Mayari Sucker Rod.

The Bethlehem "X" Mayari Rod has what it takes for economical service in corrosive wells—particularly those wells where carbon dioxide is the main corrosive agent—because it is made from nickel-chromium-molybdenum steel. The rod is fully normalized to obtain uniform mechanical properties, and it meets API Specifications. It is regularly furnished with carburized, hardened-and-ground A4615 couplings.

If you'd care for additional information, either about the "X" Mayari rod or any of the other sucker rods and accessories produced by Bethlehem, get in touch with our nearest distributor or sales office, or drop us a line at Bethlehem, Pa.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

BETHLEHEM *Sucker Rods*

BETHLEHEM STEEL

Shot Pattern Effect

On Rock Reactions

By F. R. COZZENS
Field Foreman, Equity Oil & Gas Company

THE most intricate and by far the most confusing process involved in the completion of an oil well is the process of shooting, by which explosive energy is pitted against the physical resistance of a reservoir rock. At detonation, a charge of nitroglycerin in a sand-bore becomes comparable in one respect to an atom bomb. Immediate effects can be determined and charted. Repercussions and reactions are unpredictable, and may occur within weeks, months, or even years after the force is released.

In a practical sense, the objective of a modernly designed oil well shot is to provide, through an array of energy-created fissures, a two-way transport system, over which fluid is conveyed from the sand to the well as production, or from the well back into the sand as a pressuring agent. The entire system is established by direct action, and generally by a single blast. Functioning of the system from then on is largely dependent upon operative practices in relation to structural reactions which occur in the affected area.

All shot-fractured sand bodies undergo readjustments, many of which are not observed during the period of primary oil production because natural reservoir energy is sufficient to keep the fracture patterns open and intact. Following natural depletion, however, and especially after some form of mechanical energy is applied, reservoir reactions become more pronounced. Assuming that all wells on a repressured project are in good operating condition, and the driving energy up to par in quality and quantity, any disturbance which closely resembles a premature pressure breakthrough should be viewed with suspicion. Disturbances in production on scattered wells during the early stages of repressuring, such as frequent pumpings of very gaseous or frothy oil, unexpected gas-heads, dirty fluid, or the fluid coming in spurts as if the well were pumping down, especially when accompanied by fluctuations in pressure induction, are very suggestive of reactive conditions, and the three factors most commonly responsible are as follows: (1) a secondary crumbling or caving of the sand-face and channel walls, particularly when water is used as the pressuring medium. (2) Release of fracture-sediment into the channels during transition from natural pressure to mechanical pressure; and (3) partial collapse of the channel pattern, due to masses of fractured rock sliding or settling from pressure vibrations. Each of these reactive factors seems partial to particular types of sand-structure, and they rarely are encountered in combination.

Secondary crumbling of a sand-face and channel system is present to some degree in practically every water-flood project. Ordinarily, the disturbance is slight and except for occasional sediment in the pumped oil, it may escape notice. However, this condition can become serious if not detected and arrested early, and the generally accepted explanation for such reaction is that, following shooting, various portions of the fractured sand-face retained sufficient binding materials to stand up, or remain firm during the initial clean-out, and for a limited time thereafter. Stimulated later by a pressuring agent, the binding structure disintegrates, releasing its burden of sand particles. The bulk of this residue settles into the base of the shot hole, but the lighter, more soluble and mucilaginous constituents do not readily settle out of the fluid, but are pressured into the larger sand-channels, either by direct induction at an input, or by back-flowing producing wells. Various minor plugging actions occur at first, gradually disturbing production and pressure intake, and eventually the residue accumulation penetrates the sand to an extent where complete eradication is impossible.

THE AUTHOR analyzes various reactions within the producing zone which, sometimes after the lapse of years, combine to cause closure of flow channels or otherwise tend to throw the well off production. The effects of shooting and resultant gradual readjustment of the sand are investigated, and cleanout or remedial methods outlined for maintaining a well in good condition.

For early detection of secondary caving, or in tracing the behavior of other sand-reactions, many eastern flood operators are making it a rule to take sediment samples from each well two or three times per week as a supplement to the regular production records. Excess of sediment generally shows up considerably in advance of other disturbances. When thus discovered in the initial stages, serious trouble often can be averted by washing out the shot hole or sand-bore of each suspicious well, the treatments being spread over a period of three months, or until the caving tendency has ceased. Inputs are backwashed (by pressure). Producers are first pumped dry as possible, then washed out several times. The process is usually accomplished without the aid of cleanout tools by placing two or three barrels of salt-water or brine in the shot hole, and circulating the fluid through the pump for three to five hours (flow line being connected so as to discharge into casinghead). This procedure, with

new water, is repeated for three consecutive days, or until the fluid returns from the pump reasonably clean. In some wells, sediment samples reveal a high percentage of calcium, or other acid-soluble carbonates, and it is often practical to use a 15 percent solution of hydrochloric acid (hydrogen chloride by weight) as the initial washing fluid.

After continuous circulation within the shot hole for six to eight hours, the solution along with dissolved residue is pumped out, then followed by two or three similar circulations with salt water. In neglected cases, especially where the shot hole is partly clogged with sediment, cleanout tools are generally required, and washing is accomplished with an agitator, run on the drilling stem. After the sand face is cleared to the base of the shot hole or pocket, there should be a waiting period of three to five days, or until the strength and firmness of the walls can be determined. On many jobs, heated water (180 to 200° F.) is used as the cleanout fluid, the objective being to hasten and terminate the caving action while the annulus is open and accessible to bailing. This process is particularly successful in cases where intermittent caving has persisted despite repeated pump-circulation treatments. Wells should not be back-flowed, nor permitted to head-up for at least six weeks after treatment, so as to allow as much residue as possible to be pressured out of the sand channels. Incoming residue during this interval can usually be cleared through the pumps, provided that working barrels are located near the base of the sand.

Caving reactions seldom extend beyond the range originally shattered by the shot, and complete clearance of the area usually solves the problem. In certain types of sand, however, the reactive condition is stimulated by clay constituents of the structural mass. An over-balance within the structure of either a calcium or sodium clay or shale can be responsible, and the reactive status is usually detected by the spongy or mushy appearance of the sand sediment, especially if the samples are immersed a few hours in fresh water. Upon such affected wells, operators generally favor a dense concentration of brine (100 pounds granular salt to 50 gallons of water), or solutions of alum or sodium aluminate, as a cleanout fluid. The objective is to flocculate or shrink the clay particles, thus providing a firming and stiffening effect to the sand-face binder. Fresh water should never be used in the cleanout process, and it must be kept in mind that various elements in flood water can induce this type of caving, through both chemical and reservoir reactions. Sediment samples from all suspected wells should be analyzed before a flood-water composition is applied.

Penalty of Neglect

Release of fracture sediment, comprising the second major form of reservoir reaction, is caused in fully 80 percent of all cases by neglect and delay in transferring depleted properties from natural pressure to mechanical pressure. The basic factor originates when a well is shot, since it is a proven fact that months and often years are required for all fracture particles and residue resulting from the blast to pass down the channel system and into the well. This residue must of necessity follow a circuitous route because sand strata do not fracture uniformly, either in distance or direction. Resultant flow channels are thus irregular, and due possibly to deflection of shot-force by shale lenses or other impediments there are frequent valleys or dips. Active fluid movement through the structure keeps these valleys open and free of incoming sediment, but when fluid movement is sluggish, or ceases entirely, the valleys become catch basins for refuse from minute branch fractures and the capillary network. Into each dip or low spot along the course sediment is deposited, gradually accumulates, and often crystallizes. Later, when new driving energy is pressured into the system, these plugs do not move out as expected, but often expand more firmly against the channel walls.

Unless a detour is made by the pressuring agent through unfractured sand around the plug, the drainage system to that point is blocked, and most of the oil in the affected area becomes trapped. This condition is likely to be encountered to some extent in any badly-depleted well which has remained untreated and off the pump for considerable time, and while some improvements can generally be made on the drainage system, a damaged pattern seldom regains its original capacity. Approved treating methods: (1) Reshooting with liquid nitroglycerin (10 to 20 quarts) or with solidified nitroglycerin (100 percent gelatin) in packs of 100 to 150 pounds, the charges in most cases being dry-stemmed with 10 to 15 feet of road chat, or sand; (2) applications (three or more) of hydrochloric acid solution or acetone under pressures sufficient to thoroughly penetrate the pattern. Favorable results are also obtained on some wells by using an acetone solution as a primer, followed by high pressuring with natural gas, and by the temporary use of chemical agents which are designed to break down the composition of the plugs. A far more practical course, however, is to redrill in the immediate vicinity, and process the old well for later use as a supplementary producer. A shot for the redrilling can often be designed to intercept the original fracture pattern so that considerable of its trapped oil can be recovered through the new annulus. Serviceable portions of the original pattern prove useful in helping to establish a more uniform flow of fluid through the reservoir, and in areas where an active and continuous fluid movement can be maintained from the time a well is shot until its economic life has terminated.

Preparation of a well for cleanout shot requires treatment as careful as that followed when initially bringing in the well, and may have even greater influence on subsequent production.

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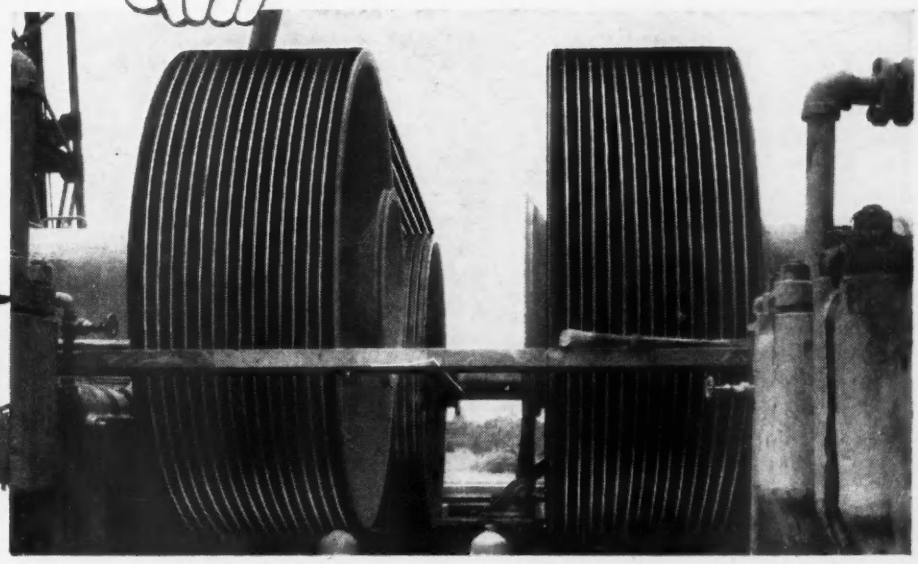

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fracture plugging reactions are practically non-existent. For this, and for other reasons equally important, the so-called "transition gap" between the primary and secondary recovery of oil should be eliminated entirely. Before natural reservoir energy has waned to a stage where well-stripping practices have become routine, provisions should be in readiness to make up the deficit with energy supplied from compressors. Such gradual introduction of mechanical energy causes less reactive disturbances in the reservoir, and consequently more oil is recovered with less expense and delay.

Channel-Collapse

Among all the various reservoir reactions which influence the production of oil, the major disturbance most commonly overlooked is that of channel-collapse, caused principally by the settling and squeezing actions of broken rock. All consolidated sand bodies are less stable after fracturing, especially if the entire column from top to base has not been shot through. Certain zones are weakened further because the binding structure is more responsive to the blast than are the sand particles, and there is often a lack of uniformity in the composition of binding materials. When pressures greater than those originally contained in the reservoir are introduced through the shot-patterns of such sands, the rock masses vibrate. Continuous wave pulsations create jarring motions which eventually cause segments of fractured rock to slide and settle until portions of the drainage system collapse by sheer weight. In a more practical sense, loosened sand particles pack down in a mass, and when this occurs in close vicinity of the shot hole, as is commonly the case, many of the major drainage outlets are closed. Extent of damage by this action cannot be readily determined, and much of the pattern often becomes involved before detection. Sharp rises on the pressure-gauges at nearby inputs are usually the first indication, followed by the appearance of cloudy or muddy fluid at the affected producer. Channeling and bypassing later become troublesome, as concentrated driving energy forces escape through detours around the closed area of sand. In producing wells, excessive bypassing, attributed to other causes, is often due to a major collapse at some point along the drainage route. This fact is proven, when, upon reopening the drainage pattern by mechanical methods, the bypassing tendency subsides.

The initial corrective step in controlling reactive disturbances in a sand of this type is to provide pressures compatible with its structural stability. A continuous low pressure is generally more satisfactory than high induction, and intermittent injection or slugging should not be attempted. It is also found that gas, if cost is not prohibitive, is more satisfactory than water. In no cases should raw or untreated water be used, and any existing beds of shale or slate immediately above or below such sands should never be flooded. While badly damaged patterns can never be reconstructed, they can as a rule be revamped and improved until fairly adequate drainage is restored. The most approved treatment is light reshooting with liquid nitroglycerin (1½ to 3 quarts per foot of pay sand). Light, multiple shots (2 or 3) applied a week apart, each charge followed by a cleanout, are proving especially successful. Extremely soft, pebbly sand (within which most channel collapse occurs) is seldom shot, the walls being protected by spacers between stub shells, and in some wells, the soft zones are segregated by using packers, or by spraying with plastic compound or cement. All repaired wells should be closely observed, and given frequent washouts with brine. Any leaks in or around casing or packers must be repaired immediately, since these types of sands take self-inducted water at a surprising rate.

Sand Responsiveness

Due to the very complex composition of an oil-bearing formation, and possibly also to magnetic and chemical influences not clearly understood, the physical intensity of a sand reaction cannot be fully determined by any method known. It is a phase of sand responsiveness to explosive energy, and evidently, a geologic effort to regain or rebalance structural resistance destroyed by the blast. The disturbance may be confined to a single shot pattern, or may envelop an area of many acres, and no formation is entirely immune. Many reactions are beneficial to the recovery of oil. Others are adverse, and an all-out effort should be made to keep adverse disturbances as far distant as possible from inputs and producing wells; the most practical recipe being operating practices which promote an active and uniform fluid circulation through the reservoir. Once an adverse reaction arises in a shot-pattern, however, three initiative steps are essential: (1) Early detection. (2) Prompt action. (3) Adequate working knowledge of the structure so that corrective measures can be applied at an opportune time.

Vapor-Liquid Equilibrium

■ CONTINUED FROM PAGE 175

both. The succeeding discussion is concerned only with a condensate field in which three fluid phases—gas, oil, and water—are present.

According to Leverett,[4] water is present in a reservoir in the form of pendular rings around the grain-to-grain contacts. He also states that "the solid, where not covered by water in the pendular rings, is covered with a very thin film of water if the solid is completely wet by the water." Only a few exceptions are known where the water does not completely wet the solid in petroleum reservoirs. Therefore, the water fills the smaller interstices and capillaries and eradicates liquid surfaces where the radius of surface curvature of the liquid is least. While the vapor pressure of the water might be lowered slightly under these circumstances, it is not important and would not affect the ultimate recovery of the hydrocarbons.

Since water fills the smaller interstices and capillaries of the reservoir rock, only the larger capillaries will contain gas or condensate. If these larger capillaries contain hydrocarbons, the vapor pressure will not be appreciably affected due to the larger radius of curvature of the liquid condensate, even at low saturations. As the vapor pressure of the condensate is not changed, the fundamental equilibrium relations determined with conventional laboratory equipment can be used to predict the behavior of a given hydrocarbon system.

Since the sand or reservoir rock in an actual field does not affect vapor-liquid equilibrium significantly, it can be concluded that the reservoir rock may be neglected as a factor in calculations and laboratory experiments designed to predict the history of a condensate field.

These determinations may be used to study the various methods of producing a condensate field such as straight pressure depletion; recycling at high or low pressures; simultaneous recycling and pressure depletion; and partial recycling followed by pressure depletion. The results of these studies are a valuable aid in selecting the method which would yield the highest economic return from a specific field.

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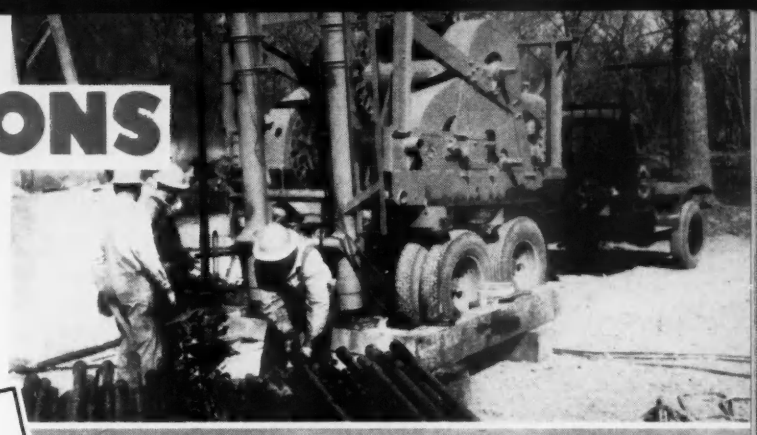
4 GOOD REASONS
why A. J. SUTHERLAND is a top operator



SUTHERLAND SAYS . . .

1. "*We purchased our first Cooper — Allis-Chalmers W201-26 Single Drum Skid in September, 1946.* This proved to be an ideal unit for servicing this area, most 2000' - 3000' with 2" and 2½" tubing. Did numerous rod jobs and some tubing jobs to 4150' with the unit."

2. "*We purchased the second W201-26 Double Drum Skid in August, 1948.* This unit was so well received by our customers that we also equipped our first W unit with a second drum. We did considerable bailing and swabbing, as well as rod and tubing jobs with these machines pulling over a Cooper 50' Single pole mast. 4000' round trip rod jobs were done in 5 to 6 hours well time, and 2500' to 3000' round trip and rod tubing jobs laid down in 8 to 9 hours well time."

3. "*Our third unit was a Cooper Model M318-32 Double Drum Skid, purchased in April, 1949.* This unit has air controls and Cooper 65'-2 pole mast. We use this unit primarily on 4000'-4500', but have pulled 5400' of 2" and 2½" upset tubing, and Kobe strings in the 4500' range. Round trip on 4000' rod and tubing jobs, 2½" upset tubing and ¾" rods laid down, average 12 hours well time."

4. "*Our fourth, a Cooper Model E563-36 Double Drum Skid equipped with Air Controls and Cooper 65'-2 pole mast, was purchased in March this year.* This unit is capable of handling 6000', wet strings, of 2½" upset tubing."

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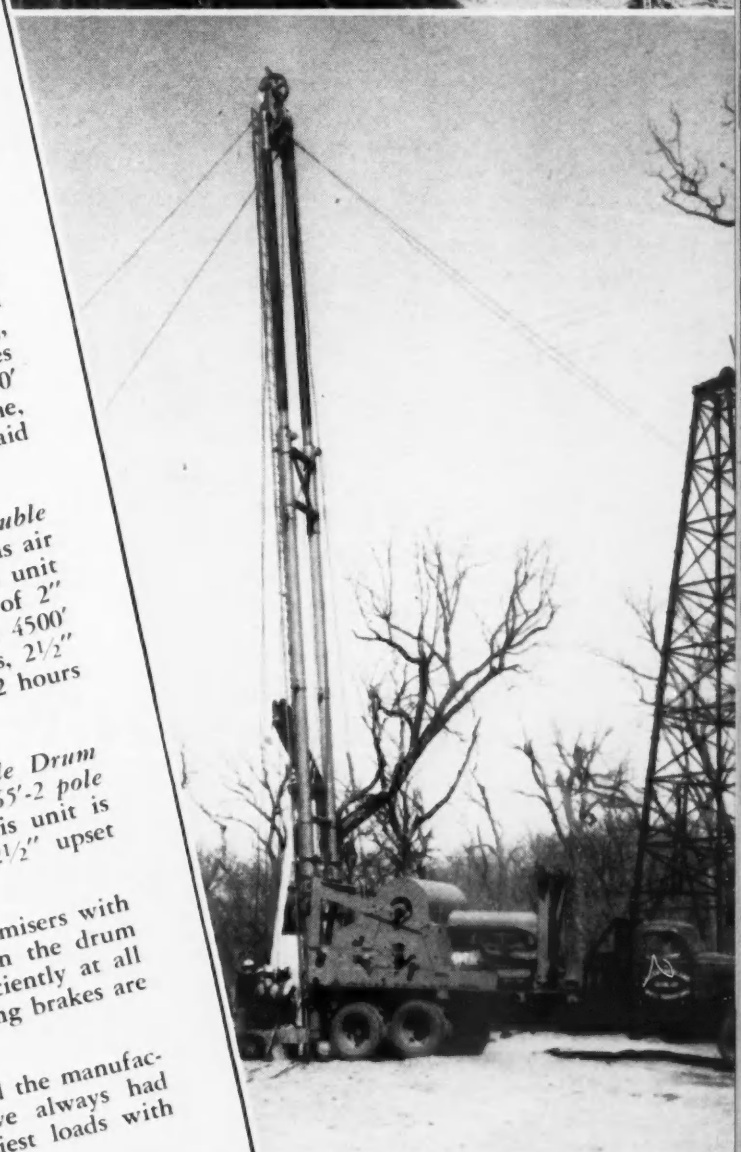
"Even though we have considerably exceeded the manufacturer's recommendations at times, we have always had ample braking power to control the heaviest loads with ease and safety."



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PRODUCTION HINTS

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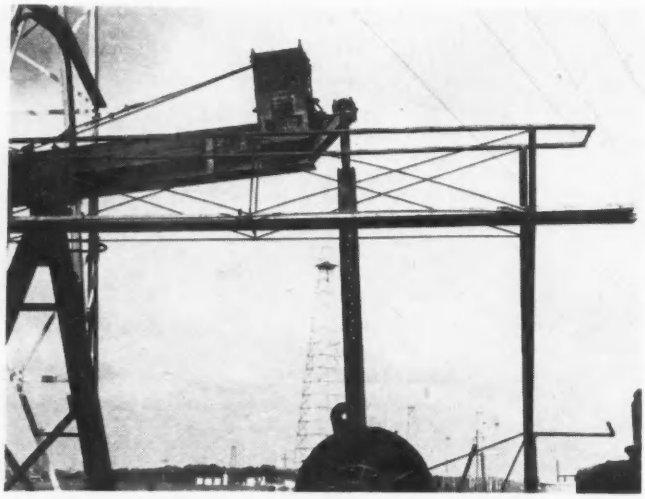
HOW TO—Provide Access to Pumping Beam

To allow the pumper to adjust the counterweights, and also to provide safe support while lubricating the samson post and stirrup bearings, one company equips its wells with a light walkway which is suspended within the Vee of the derrick at one end, and carried on two 2½-inch pipe standards at the other.



The walkway frame is welded up from two-inch pipe, with two longitudinal support members and three cross units. Uprights at both ends carry the handrail, also of two-inch pipe. Tie rods of salvaged five-eighths-inch sucker rod are put between the uprights and the adjacent cross members of the support and handrail longitudinals, and are set with sufficient tension to assume their share of the load before being welded into place.

When completed, the frame is equipped with two 2x12 floor planks, held in place by driving 20-penny nails through the boards so as to span closely the cross members of the steel frame.

The walkway is strong enough to support several times its normal service loading, and rigid enough so that there is no sway or vibration to interfere with the work the switcher is performing while on the walk.

HOW TO—Store Piping Materials at Yard

The problem of storage space and being able to find miscellaneous piping and tools in the warehouse prompted a large drilling and well maintenance firm in California to fabricate this convenient and useful pipe storage rack. Not only are leftover lengths of well casing and line pipe stored here, but reclaimed liners, formation testing tools, and other tubular goods. Long, heavy items are stored near the bottom where it is easier to handle the pipe, while short, lighter pieces are placed in the upper brackets.

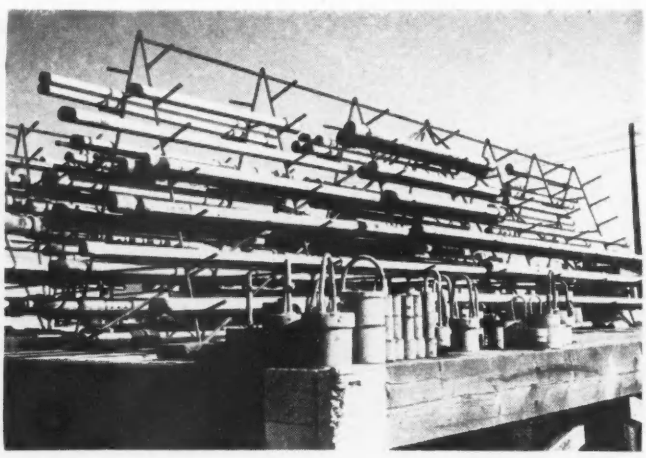


Photo Courtesy The Lincoln Electric Company

Two such racks are placed parallel to each other in the illustration. The rack is made of heavy sucker rods, welded in large A-frame shapes. It is cross-braced at the bottom and angular braces extend from the top center to the outside ends to prevent lateral movement. Short pieces of sucker rod welded at right angles to the legs of the seven A-frame members provide supports for the piping materials. Each rack extends almost to the end of the elevated warehouse platform, providing enough space at the ends to walk around the storage racks. Since the platform is at truck-bed level, it was no difficult matter to unload or load field trucks with required materials.

These storage frames are relatively light and can be moved to other warehouse platforms in the event that storage facilities are enlarged or changed. Lifting subs and other often-used items are also stored on the platform for easy identification.

PRODUCTION HINTS

HOW TO—

Raise Temperature In Meter Enclosure

In high-pressure gas-condensate lines, the hydrate problem is a difficult one even in mild climates, and it is particularly bothersome in freezing weather. To prevent any freezing of the lines in the meter house, one company improvised a heater below the enclosure in order to increase the temperature around the meter and piping.

A gas supply line was laid from the lease fuel system to the improvised meter house heater. The heater body consists of two pieces of four-inch pipe connected together by an ell. The longer section,

approximately six feet long, serves as the heater stack, while the shorter piece, about four feet long, forms the heater body. The latter piece is fitted into holes cut in the lower side of the meter house so that the four-inch pipe is below the meter piping inside the house.

A damper is placed in the stack by taking a piece of flat plate steel and attaching it to a welding rod so that the rod acts as an axle for the damper. The burner is made by screwing a one inch tee to a reducer over the three-eighth-inch gas line. The other end of the tee carries a nipple which extends a few inches into the heater. The end of the three-eighth-inch gas line is plugged and a 1/16-inch hole drilled in the end so that a jet is provided. During the extreme winter season, the heat generated by this improvised meter house heater prevents freezing of hydrates that may be in the line, and also keeps the recording mechanism free for accurate recordings.

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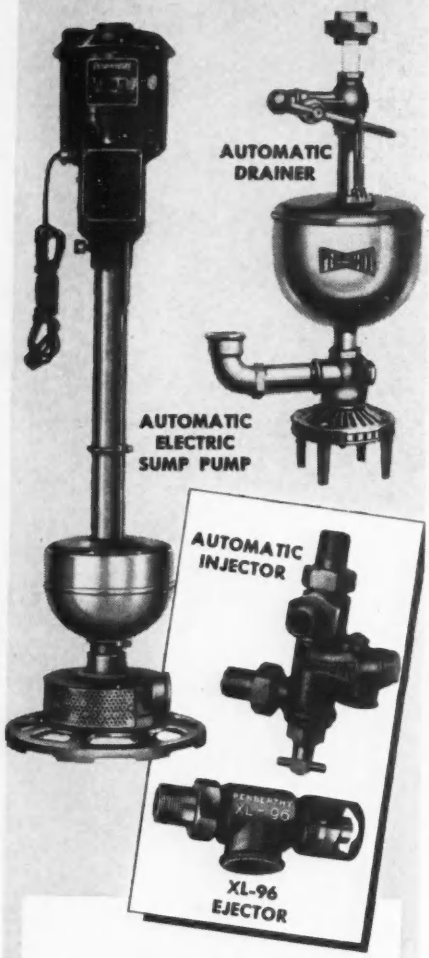

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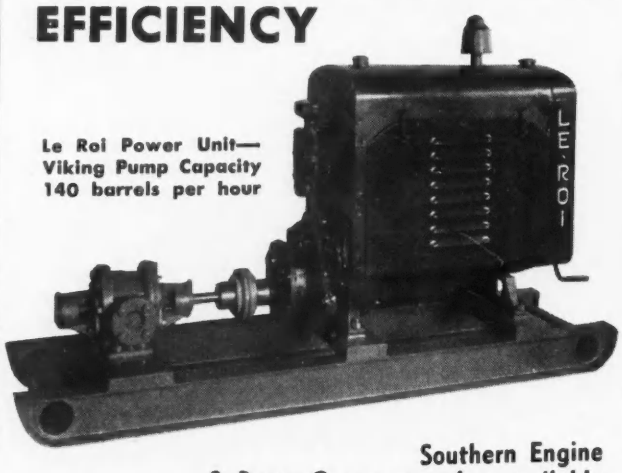
HOW TO—Support Exhaust Stack

To reduce the amount of work ordinarily required to rig up and tear down equipment on its truck-mounted well-pulling unit, one company employs an unusually simple method of supporting and directing upward the exhaust stack of the drawworks engine. A length of flexible metal hose is used as the tail pipe that is attached to the muffler, the latter being installed horizontally a few inches above the engine hood. When the pulling unit is travelling over the road, the flexible tail pipe can be dropped down beside the engine. When the unit is set up on the well, the tail pipe can be brought up to a vertical position and held there by a light chain, the latter attached to a short length of rod or pipe which is set in a socket welded to the upper surface of the exhaust stack elbow.

In the installation shown, the exhaust tail pipe is rigged for operation at the well. Wind or vibration cannot cause the pipe to fall over. Erecting or lowering the tail pipe is accomplished in a matter of seconds, and involves no making up or assembly of pipe or pipe fittings.

THE RIGHT TEAM FOR EFFICIENCY



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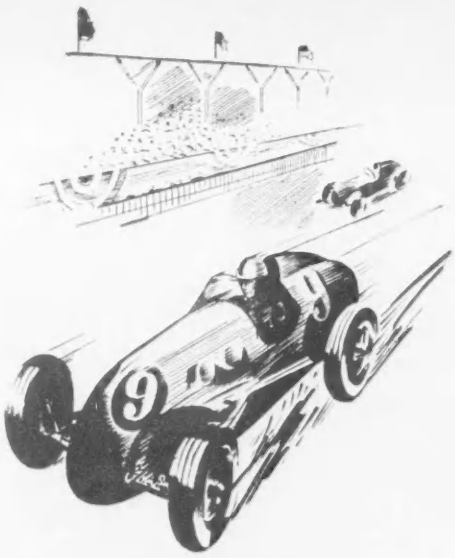

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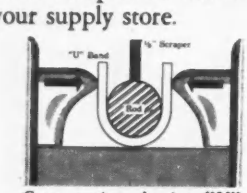
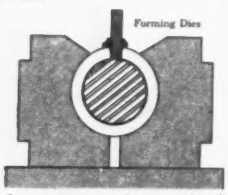


Cross section showing "U" band being die-formed around rod to the scraper blades.



Cross section showing band held under pressure around rod while ends of band are shrink-grip attached to scraper blades. Neither scrapers nor bands are welded to sucker rods.

CRALL Spiral Paraffin Scrapers fit any sucker rod for 2" or 2½" tubing. Order your CRALL Scrapered Rods from your supply store, or wire, write, or phone for full descriptive literature.

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When different types of pulling machines for rod and tubing jobs are in service, a holddown to fit any of them can be constructed and left permanently at the well. A concrete ramp is built at the well and connected to the slab around the casing. Portions of the old slab are broken away so the new piece of concrete may be poured as desired, and the anchor bolts are set in place.

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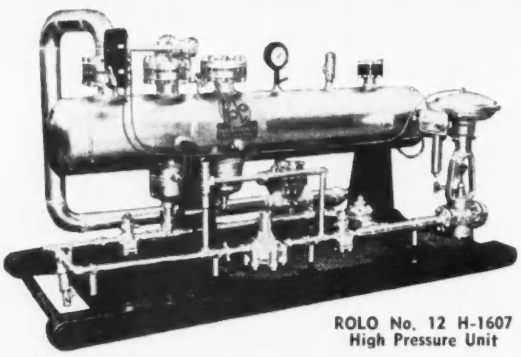

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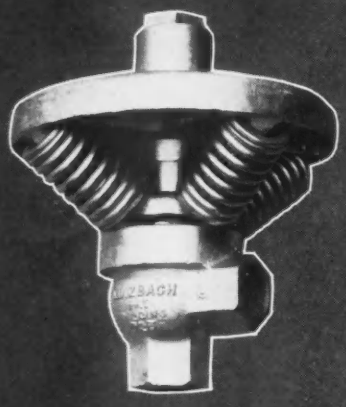

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The Model 112 Valve can be used for any mud relief application, including compounding operations. Field tests prove conclusively that the Kinzbach Valve offers every operational advantage required for efficient mud operations. Write for full technical data. Ask for bullentin 11250.

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PRODUCTION HINTS

HOW TO—
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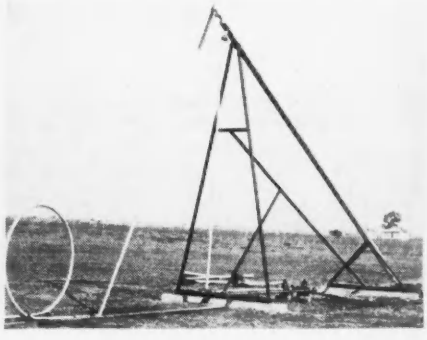
For the numerous instances in which electric power is required for miscellaneous uses around the lease, one company employs an unusually compact and efficient gasoline powered unit that is easily transported from job to job. Illustrated is the small generating unit mounted on a skid base. The front end of the base is equipped with a pair of semi-pneumatic tired wheels and the back end is provided with a tongue-type handle with which a man can maneuver the unit along the ground once it is unloaded from the truck.

Equipped with a long extension cable, the unit can be rigged up and put in operation within a few minutes.

HOW TO—
Protect Connections Of Water Knockout

To protect the welded framework and connections of an elevated water knockout from expansion changes in the long



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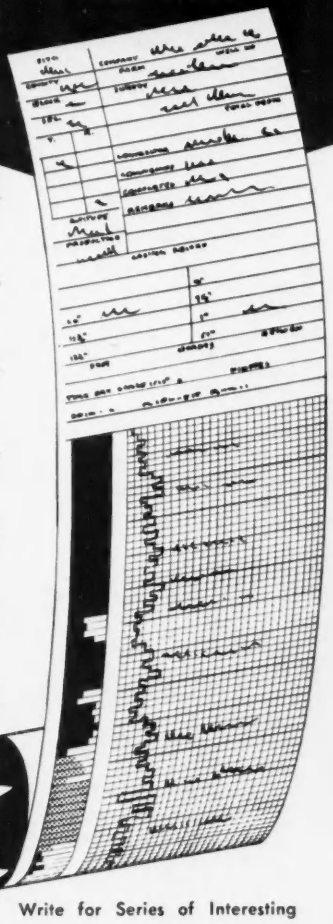

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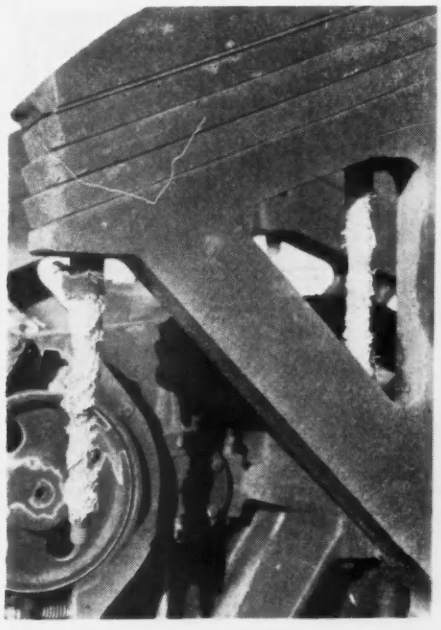
PRODUCTION HINTS

above-ground lead line from well to field line connection, a 360-degree loop was formed in the line, and the loop anchored at the side toward the well. The expansion or contraction of the line then was absorbed by minor variation in diameter of the full circle, and the knockout mounting protected.

The loop also served to absorb, or rather to prevent, any vibration set up in the knockout by intermittent or slugging production from reaching down the line and possibly affecting connections.

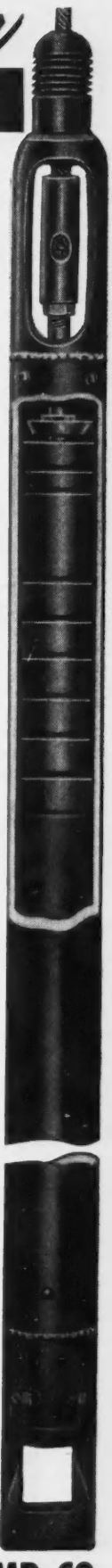
Mounting of the loop was accomplished by setting a narrow block of concrete into the ground, aligned with the flow line, and fastening the well side of the loop and the adjacent end of the short horizontal run to the base with U-straps over paired bolts.

HOW TO—
Guard Threads of Counterweight Bolts



Exposed to weather and infrequently inspected, the threaded bolt which holds or clamps the counterweight sections in place on the pumping unit crank often become rusted and difficult to handle. The production department of one company eliminates much of this rust and corrosion problem by coating exposed threads with grease and wrapping the length of each bolt with burlap or cloth stripping, the latter then being tied in place with twine or wire. Where weather conditions are severe, additional protection may be given the threads by periodically soaking the burlap covering with light engine oil or penetrating oil.

Miller SAND PUMPS



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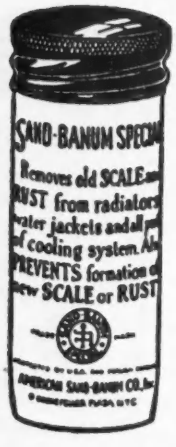
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PRODUCTION HINTS

HOW TO—Handle Field Lubricants

The efficient handling of oil field lubricants in a safe manner is a step toward proper equipment maintenance. By making available the different types of lubricants required, and clearly identifying them, the operator can better be assured of proper equipment care.

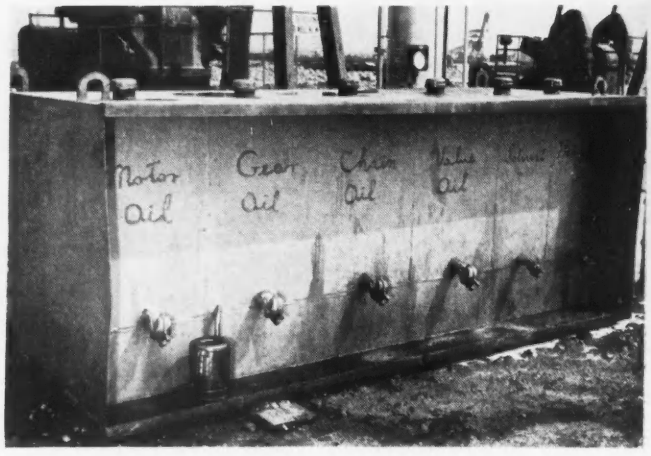

Photo Courtesy The Lincoln Electric Company

This convenient lubricant dispenser was made of one-eighth-inch plate steel and equipped with eyes at all four corners so it could be handled easily by truck. The identifying lubricant sign at each tank division was weld-written and painted a contrasting color. Separations inside the tank are made of the same plate steel used in the outer sides.

Handy pipe outlets welded to the top of each individual tank and fitted with cap screws serve to fill the tanks. Lubricants are dispensed at the bottom of each tank through handy cut-off valves welded in place as shown. A piece of angle iron welded to the bottom plate and extending across the unit prevents overflow from spreading over the ground.

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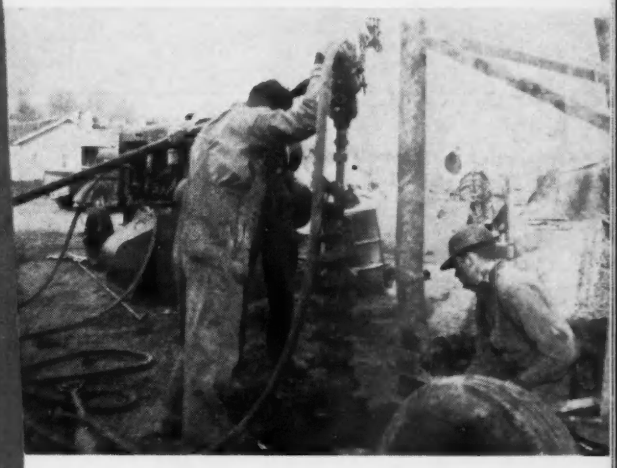
Foundation Stabilization Whips QUICKSAND Problem



Drilling auger holes which later were pumped full of grout.

By ANTHONY GIBBON
Mid-Continent District Editor

TWO STRATA of quicksand were encountered under the site chosen for station equipment, and both were stabilized by pressurized cementing with a special mix which drove out water from the voids in the unstable strata and replaced it with a cement matrix which showed to have all desired foundation strength.

STABILIZATION of the subsoil under the crude oil pumping units at Stanolind Pipe Line Company's Carrollton Station was successfully completed with the intrusion process of injecting a specially treated portland cement grout. The entire work was completed without disrupting the normal operations of the pumping station at any time. This work not only halted serious settlement of the engine foundations, but also effected raising of the settled units and reduced the vibration in adjoining areas of the plant.

Intrusion grout being pumped into primary system of augered holes to form curtain wall. After mortar hardened, secondary system was augered between piles of primary system and filled with mortar, making a continuous wall.

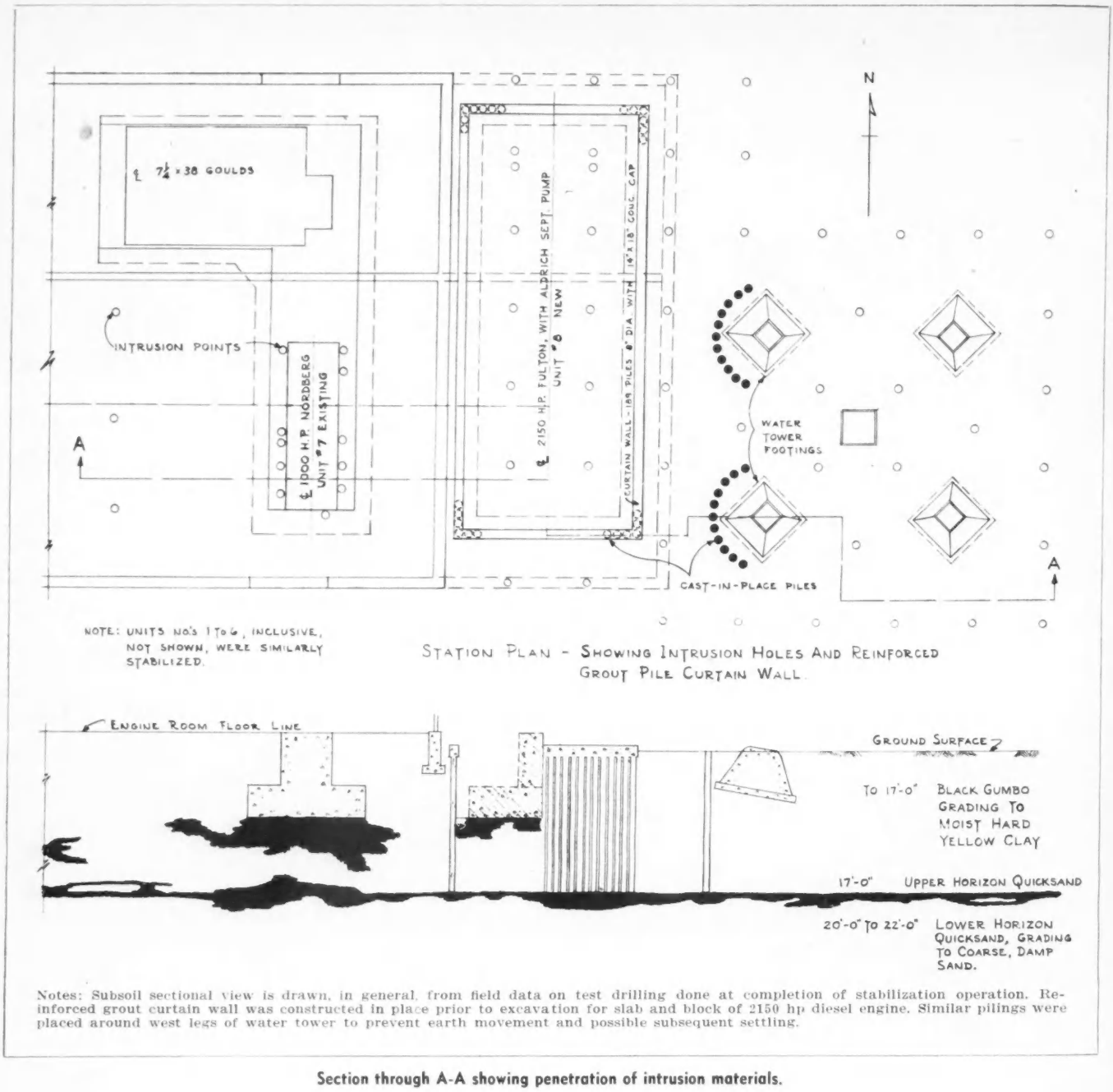
The Carrollton Station is on the southeast outskirts of Carrollton, Mo., and is one of the main line pumping stations between Houston and Whiting, Ind. The subsoil in the station area is an unstable damp yellow clay underlain by a stratum of fluid quicksand about 17 feet below ground level. Under normal conditions, the subsoil maintained a somewhat precarious state of equilibrium in carrying an average load of 1200 pounds per square foot. Experience had shown that open excavation in the area easily upsets this equilibrium—that the resultant flow from load concentration under the engine blocks to the excavation was evidenced generally by settlement of the engine nearest the excavation.

Vibration of the pumping units themselves, together with the above soil condition, caused undue settlement to several engine foundations as much as three inches, first noticed in July, 1948. Thus in the fall of 1948, with plans in hand for another new pumping unit which would extend quite close to the existing water tower already experiencing vibrational disturbances, Stanolind engineers decided something had to be done immediately to remedy the problem.

The contractor selected to execute the work was a firm specializing in foundation stabilization and the repair of concrete and masonry structures. They proposed to stabilize the existing engine foundations by filling all voids under and around the foundation that contribute to the motion of the footings supporting the engines by their patented process of intrusion. By this method it would be possible to effectively add mass to the foundations by materially improving the rigidity of the soil under and adjacent to the footings.

Also, in conjunction with the new pumping unit to be installed, it was proposed to place a curtain wall consisting of reinforced cast-in-place intrusion piling around the new engine foundation, which was designed for three purposes as follows:

1. To take the place of any sheeting required for the necessary excavation.
2. To act as a stabilizing factor to the soil, eliminating the lateral flow of moisture around and below the new foundation.
3. To develop inertial resistance (damping effect) to lateral dynamic forces


℄ 7¼ x 38 GOULDS
INTRUSION POINTS
℄ 1000 H.P. NORDBERG UNIT #7 EXISTING
℄ 2150 H.P. FULTON, WITH ALDRICH SEPT. PUMP UNIT #6 NEW
CURTAIN WALL - 189 PILES 8" DIA. WITH 14" x 18" CONC. CAP
WATER TOWER FOOTINGS
CAST-IN-PLACE PILES
A
A
N
NOTE: UNITS NO's 1 TO 6, INCLUSIVE, NOT SHOWN, WERE SIMILARLY STABILIZED.
STATION PLAN - SHOWING INTRUSION HOLES AND REINFORCED GROUT PILE CURTAIN WALL
ENGINE ROOM FLOOR LINE
GROUND SURFACE
TO 17'-0" BLACK GUMBO GRADING TO MOIST HARD YELLOW CLAY
17'-0" UPPER HORIZON QUICKSAND
20'-0" TO 22'-0" LOWER HORIZON QUICKSAND, GRADING TO COARSE, DAMP SAND.
Notes: Subsoil sectional view is drawn, in general, from field data on test drilling done at completion of stabilization operation. Reinforced grout curtain wall was constructed in place prior to excavation for slab and block of 2150 hp diesel engine. Similar pilings were placed around west legs of water tower to prevent earth movement and possible subsequent settling.

Section through A-A showing penetration of intrusion materials.

which effect settlement in adjacent engine foundations.

The contractor first took jet borings at various locations to determine the condition of the subsoil and to check soil sampling data previously taken. Holes were drilled through the concrete engine foundations and a three-fourths-inch pipe was jetted into the subsoil. A large void together with loose wet pockets of sandy clay were found directly under the footing about 12 to 14 feet below the station building floor. Another loose porous seam was found directly above the quicksand stratum and approximately 19 to 20 feet below the floor level. Between the two uncompacted areas was a hard, moist yellow clay.

Injection of grout was started at the high level, filling the void directly below the footings. The pipes then were placed at the lower level into which the largest portion of intrusion materials was pumped.

The special materials developed and used by the contractor consisted of a grout mixture containing standard portland cement, a finely divided siliceous material, a small quantity of an intrusion aid and water. Due to its special admixtures, this intrusion grout is very fluid at low water cementing materials ratio, assuring maximum penetration and high strength. It exhibits no settling shrinkage, nor do the components settle appreciably; hence, all voids and seams are considered to be completely and permanently filled.

Along with the stabilization work of filling the voids and consolidating the loose subsoil, full advantage was taken of the hydraulic pressure exerted with intrusion by raising and leveling the settled pumping units. Accurate level bench marks were set prior to the grouting operations and a continuous check was made with a surveyor's level during the pumping of the holes to control any movement to the desired maximum.

Installation of the curtain wall of intrusion piling was unique. It not only served the purposes mentioned above but also effected an over-all savings in costs compared with the conventional use of steel sheet piling.

Test holes eight inches in diameter were augered in the area. The moisture condition of the subsoil proved ideal for

■ CONTINUED ON PAGE 198

CARE and MAINTENANCE

Checking Crankshafts

By F. V. COOK
Chief Mechanic, Stanolind Pipe Line Company

METHODS FOR checking crankshafts for possible distortion due to inequalities in bearing levels, are discussed by the author, who recommends procedures for bringing main bearings to a common axis through interpretation of indicator readings. He suggests permanent records from fixed datum plane—as engine bed casting—for future quick checking of shaft condition.

WHILE the following procedure for checking crankshafts is designed primarily to cover the slow-speed, heavy duty engines with thick babbitt shells, the principles will apply to any crankshaft!

1. After doors are removed, inspect crankcase carefully for evidence of hot bearings or loose babbitt to determine definitely whether it is necessary to remove bearings. Check all crank and main bearing bolts for tightness.

2. Set a jack under each crank bearing and, with a dial indicator on the crank bearing, check and record all crank bearing clearances. A magnetic base for the indicator is recommended as a safe and accurate method of obtaining these measurements.

3. Set jack under each crank web adjacent to the main bearing, and with the dial indicator on the cap, lift the shaft and record all main bearing clearances. Check and record thrust bearing clearance. The bearing clearances should be determined immediately after shutting down, while the engine is hot, so they reflect actual operating clearances.

4. Bar the engine over and take web check with strain gauge located as shown in Figure 1. If the dial indicator is set at a minus figure it will facilitate readings, as plus and minus need not be considered. Always start the check with each crank far enough past bottom center that the strain gauge can be placed in the transverse center of the crank web as far as possible from the crank pin. Record the strain gauge reading in each quarter position, ending with a second measurement with the crank as near as possible to bottom center without touching the strain gauge. This second measurement should be the same as the first; if it is not, all readings should be taken again. Also, the total of the top and bottom readings should equal the total of the front and back readings. If a strain gauge with pointed ends is used, it must be possible to rotate it on its points without moving the hand on the dial, or the readings are inaccurate. It has been found most convenient to record these measurements on a chart as shown in Figure 2, which has been filled out for a typical four-cylinder engine.

5. In the example shown in Figure 2, the shaft has now been found out of alignment and apparently needs the end bearings lowered. Few shafts would show more variation than this if a bearing were burned out, so it is necessary to check the main bearings further. This can be readily accomplished by placing

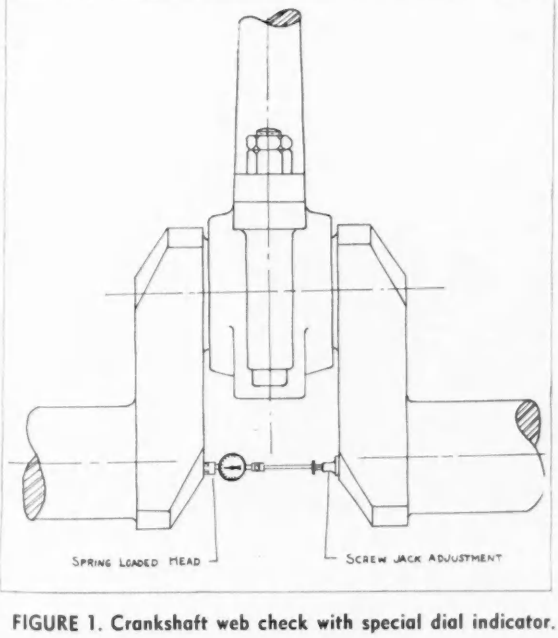


FIGURE 1. Crankshaft web check with special dial indicator.

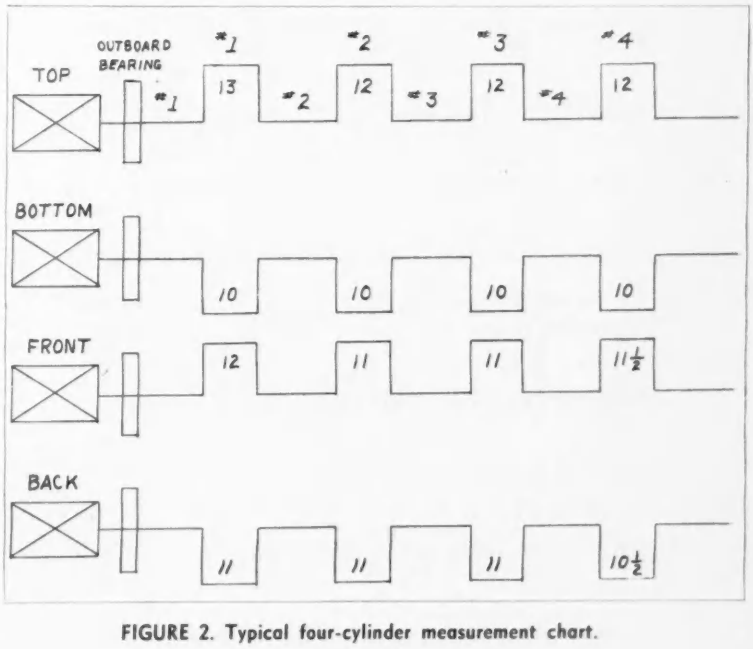


FIGURE 2. Typical four-cylinder measurement chart.

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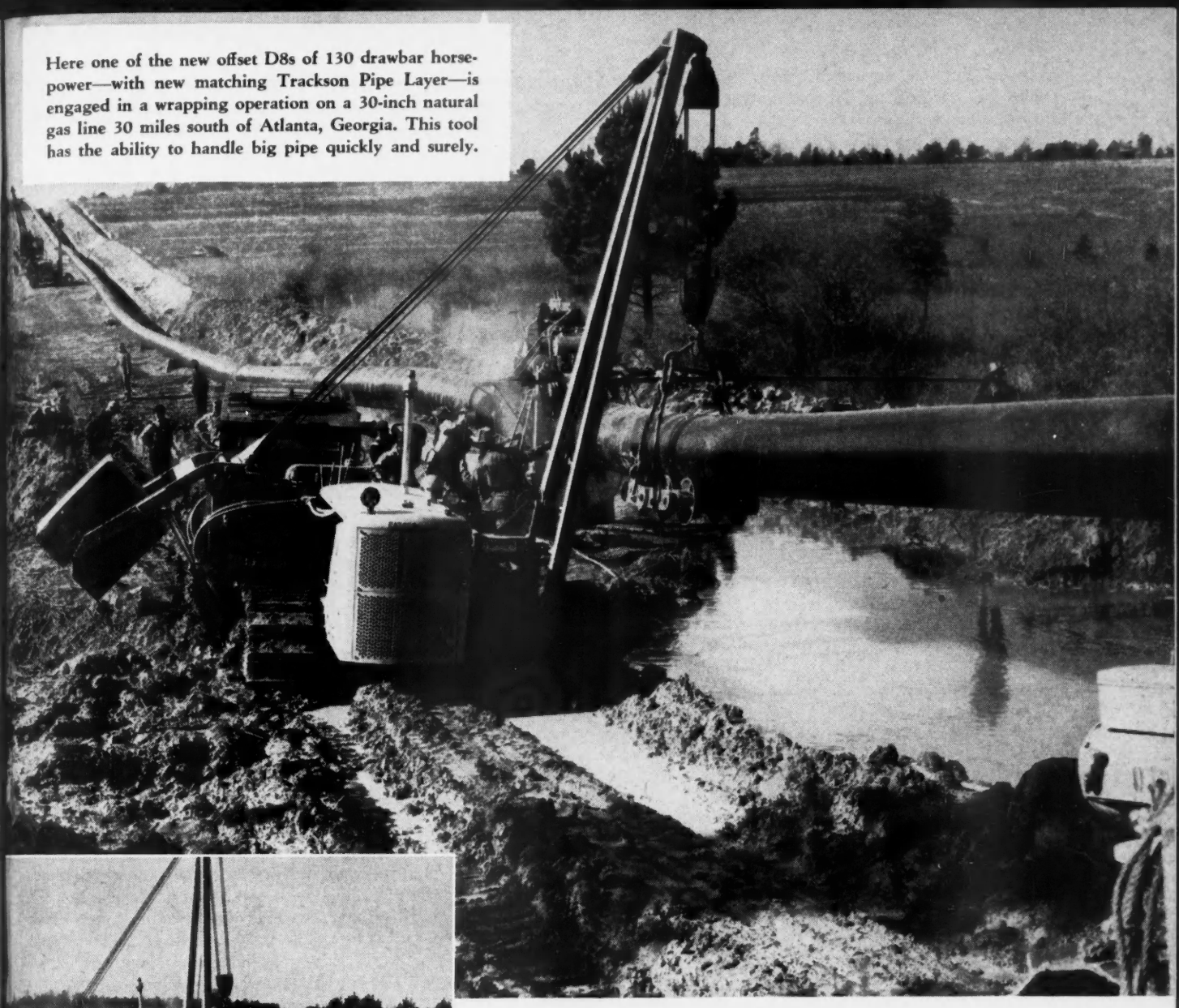
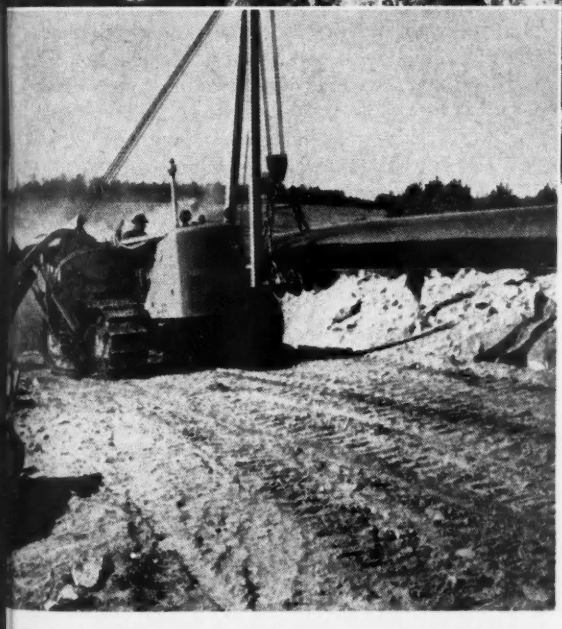
CATERPILLAR TRACTOR CO., PEORIA, ILLINOIS

Offset design of the tractor "wearing" extra wide shoes on the boom side makes this all-new unit ideal for pipe-line work no matter what the ground conditions are.

Here one of the new offset D8s of 130 drawbar horsepower—with new matching Trackson Pipe Layer—is engaged in a wrapping operation on a 30-inch natural gas line 30 miles south of Atlanta, Georgia. This tool has the ability to handle big pipe quickly and surely.





Its hydraulically controlled counterweight (10,000 lbs.) enables the Offset D8 to handle pipe of any size on all kinds of terrain.

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the jack on top of the crank web adjacent to each bearing and forcing the shaft down in the bearings, while recording this movement with a dial indicator. This will locate a burned bearing immediately; however, assuming that the shaft could not be forced down more than .002 inch, it would then be necessary to lower the outboard bearing and possibly scrape all except No. 3 bearing. Such corrections cannot be made accurately while the engine and shaft are hot and cooling rapidly, so bearings should be removed and the engine allowed to cool before corrections are started. Front and back checks show that the outboard bearing should move to the back and the No. 4 crank shows that the No. 5 bearing should not be scraped on the front side but should be scraped on the bottom and back sides.

Calculation

The amount that the outboard bearing needs to be lowered can be calculated fairly accurately. Let L = crank length and L^2 = distance from center line of No. 1 crank to center line of the outboard bearing. T equals thickness of shim to be removed. The bearing should move to correct No. 1 crank $\frac{.003 \text{ inch}}{2}$ so .0015 : L :: T : L^2. After the outboard bearing has been corrected it will, no doubt, produce a minus reading in the top position on No. 1 crank without materially improving No. 2 or No. 3 crank. This is an indication that No. 1 and/or No. 2 bearing must also be lowered. Many 4-, 6- or 8-cylinder engines consistently become low at the center main bearing, and if this is characteristic it is well to lower the end bearings below level, leaving the center main bearing sufficiently high to produce a minus .001 inch reading when the two center cranks are in top position. Then the shaft will get better before it gets worse.

The inspection procedure outlined above is recommended each 90 days. During major overhauls, after completing steps 1 to 4, inclusive, the pistons and crank bearings should be removed and the main bearings all removed for inspection. Bearings should be removed that are cracked more than 5 percent of their area or broken so they have loose babbitt.

After defective bearings are replaced and the crankshaft realigned, it should be checked relative to the bedplate with a bridge gauge to determine and record its location. Level readings should also be taken and recorded.

A properly designed crankshaft will never break if it is kept within .001 inch variation in the web check and the engine is not operated at a critical speed.

Foundation Stabilization

■ CONTINUED FROM PAGE 194

augering a series of holes without caving. The contractor had the option of either initially filling these holes with coarse aggregate and then solidifying, or by introducing the intrusion material without the use of the coarse aggregate, as field conditions determined most economical. The latter method was used since the inclusion of clean coarse aggregate could be accomplished only by casing each hole.

The contractor augered the eight-inch diameter primary pile holes 17 feet down to the quicksand stratum on 20-inch centers. When about 15 holes were driven, a reinforcing rod three-fourths-inch diameter was centered in each hole and the intrusion begun. The intrusion mortar, same as intrusion grout with the addition of sand, was pumped through a three-fourths-inch pipe directly into the quicksand at the bottom of the first augered hole. Intrusion flow was at first unrestricted in all directions, then slowed as the quicksand tightened. As this tightening became pronounced, the intrusion mortar began filling the first five or six augered holes. Residual water and spalled lumps of clay were displaced and carried to the top of each hole by the rising mortar. Pumping in the first hole was continued until the initial series of piles was filled to the top. The pipe was then moved to the next open hole and the procedure repeated for succeeding sets of from four to six piles until all primary piling was in place.

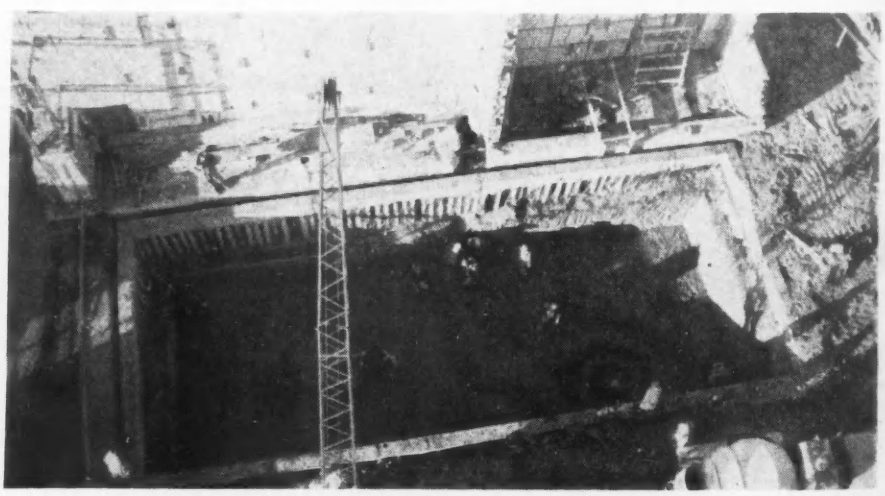
Secondary piles, on line between the primary piles, were placed by augering eight-inch diameter holes to refusal in the solidified stratum that had previously been quicksand. Reinforcing was centered and each hole filled individually with intrusion mortar.

A cap of conventional concrete, 14 inches wide and 18 inches deep, was poured around the top ten inches of the piling as an upper retaining ring for the purpose of eliminating all bracing and to provide a measure of protection during the subsequent excavation and engine foundation construction.

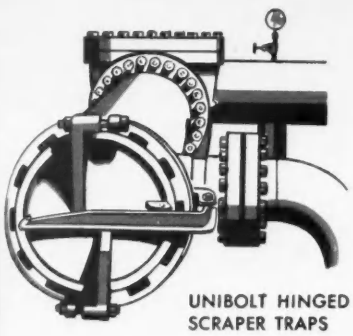
At completion, the curtain wall consisted of 189 uniform, plumb, reinforced intrusion mortar piles, eight inches in diameter on ten-inch centers. Piles were tied together by the stratum of solidified mortar at the bottom and by the concrete cap at the top.

On this job a total of 270 cubic yards of intrusion grout was used for the stabilization work, with another 50 cubic yards of intrusion mortar used in the piling curtain wall. Design of the mix calls for 12 to 18 gallons of water to three sacks of cementing materials. By varying the design of the mix to fit the soil conditions and to give the most efficient results, a maximum of economy is possible, as the intrusion mix used is always controlled to obtain the desired results most economically. Intrusion mortar of this consistency can be pumped through three-quarter-inch pipes for long distances without the danger of plugging or a separation of the components of the grout. For this reason the plant setup does not necessarily have to be close to the structure being repaired.

Upon excavation and the installation of the concrete foundation of the pumping unit, the area between the curtain wall and the concrete footing was backfilled with sand to further dampen the transmission of any objectional vibration. The results of this and the stabilization work have been excellent, showing no appreciable motion to the adjoining water tower and much less motion to the doors and windows of the station building itself, both of which previously vibrated considerably. Maximum consolidation of the subsoil was obtained together with reduction of vibration to a minimum. Therefore, no further settlement of the foundation is expected.



General view of excavation prior to constructing base for Pump and Engine Unit No. 8.



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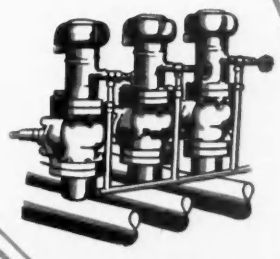

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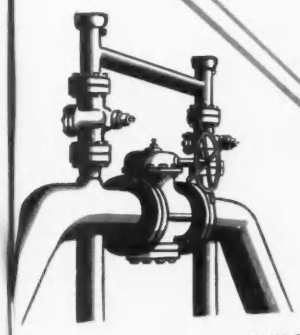

UNIBOLT COUPLINGS WITH
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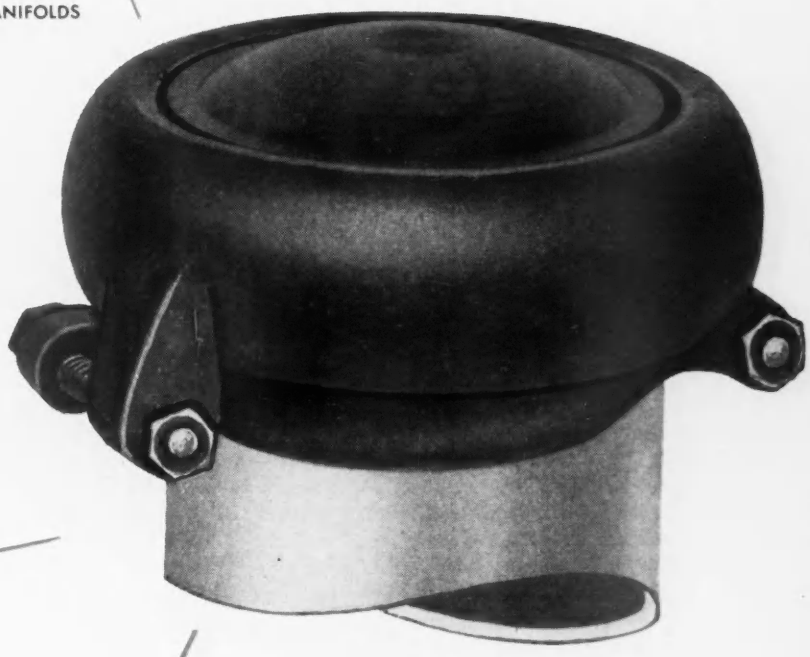
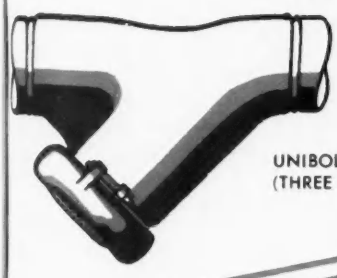
GAS LINE BLOWDOWN





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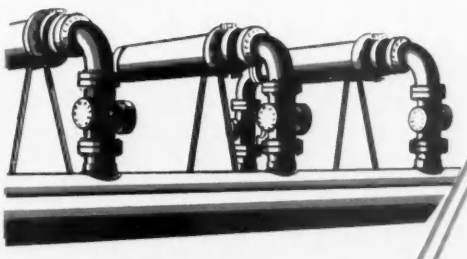

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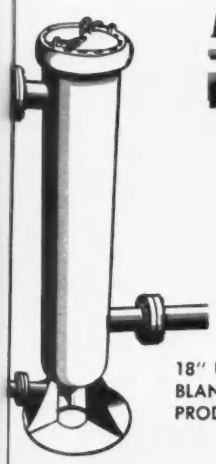

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Gas Heat Exchangers

In Transmission Systems

By F. S. YOUNG

Assistant Chief Engineer, Panhandle Eastern Pipe Line Company

METHODS FOR REMOVING the vast quantities of heat released by the work of compressing trunk line gas throughput are discussed, with special emphasis on the use of gas-to-gas exchange for transfer of the heat to the earth through the walls of the pipe line. The author presents operating costs on station installations to show that the added power requirements are proportionately small, and require a minimum equipment investment. The article was read before a regional meeting of the NGAA at Amarillo in December, 1949.

THE transmission of large quantities of natural gas through a cross-country pipe line system is an undertaking which inherently involves vast power requirements, and, since there is no way of obtaining this power with perfect thermal efficiency, the process must necessarily include satisfactory means for dissipating and rejecting the waste heat given off from the system. This waste heat appears in many forms, some of which present no difficult problems of disposal, while others require rather expensive equipment for their dissipation. The scope of this discussion is not intended to include the recovery of useful work from these heat sources, but rather to deal with economical means of handling some of those heat loads which do not lend themselves to practical recovery methods.

The primary consideration in the study of a cooling problem is this: Ultimately, the heat load involved must be rejected to one of the two large natural reservoirs, the earth or the atmosphere. The problem then resolves itself to finding the most practical way of accomplishing this end result, bearing in mind the basic factors of economy and dependability. Following this line of reasoning, it is apparent that the introduction of an intermediate stream of some cooling medium between the heat source and the heat sink, while often necessary and unavoidable, is nevertheless the first step in complicating the problem. When these cooling streams are compounded, as, for instance, in the case of engine oil cooling, the problem becomes correspondingly more complicated and involves more equipment.

Considering the example just mentioned, the oil receives heat from the engine and transfers this heat to a water stream in the conventional type oil cooler. The water stream may then carry the heat to a cooling tower where another transfer occurs between water streams, and the waste heat is finally rejected to the atmosphere in the upper part of the tower. The basic transfer of heat from the engine to the atmosphere has been achieved by means of three intermediate cooling mediums. Since the great majority of practical cooling problems involves one or more of these "connecting links" between the source and the point of rejection, it is easy at times to overlook the fundamental process. Thus, toward the end of simplification and reduction of the equipment required, the design engineer should, in general, attempt to find the most direct practical means of disposing of the heat. Therefore, when the temperature level is high enough, the possibility of direct air cooling must always be considered. Similarly, when a small heat load is encountered at a moderate temperature level, there is the possibility that this heat can be absorbed economically by a cool suction gas stream. Unless the distance between stations in a transmission system is unusually short, the pipe line, in itself an immense gas-to-earth heat exchanger, maintains the gas on the suction side of a station at or near the prevailing ground temperature, and so long as the gas temperature is not increased enough to affect materially the horsepower requirements of the station, the relatively low temperature gas stream can be used as a receiver for some heat loads. This paper will deal primarily with such applications of gas cooling and will attempt to evaluate, by comparison and analysis, the advantages obtained.

When considering the feasibility of gas as a cooling medium, certain advantageous applications become apparent, as do certain limitations which must be recognized. At stations where water is scarce—particularly in the case of those stations without gas aftercooling—the suction gas stream is well suited as an absorbent for some of the smaller station heat loads such as oil cooling; in fact, in such locations, suction gas oil cooling has been successfully incorporated with air-cooled jacket water systems to the end that open water cooling equipment with its accompanying water make-up problem has been completely eliminated. Also, in the case of automatic desulfurization plants located at the well

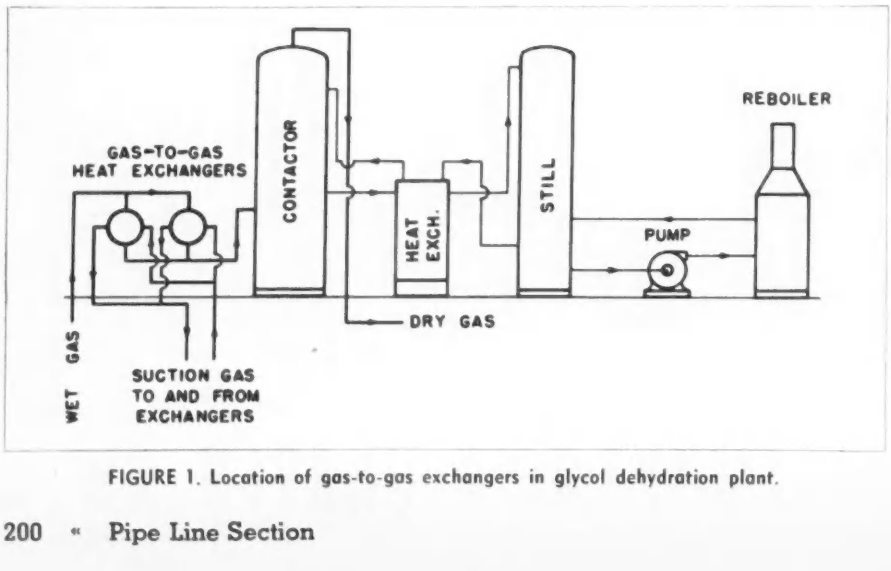
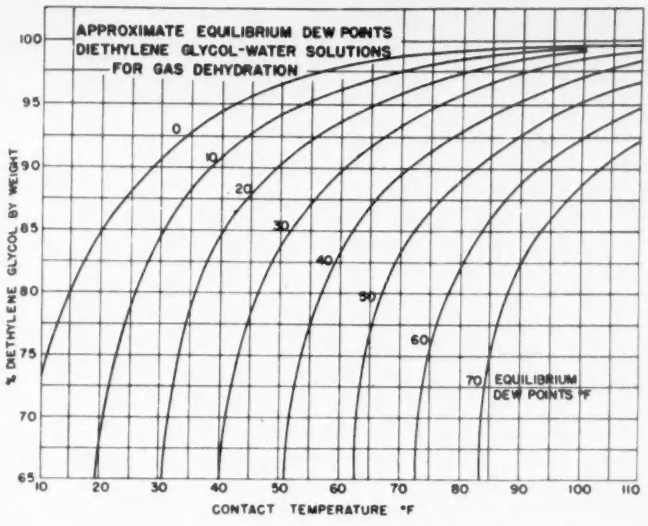
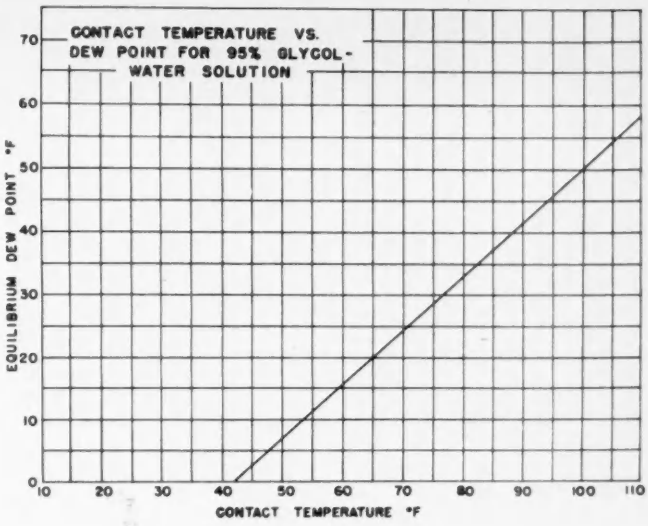


FIGURE 1. Location of gas-to-gas exchangers in glycol dehydration plant.





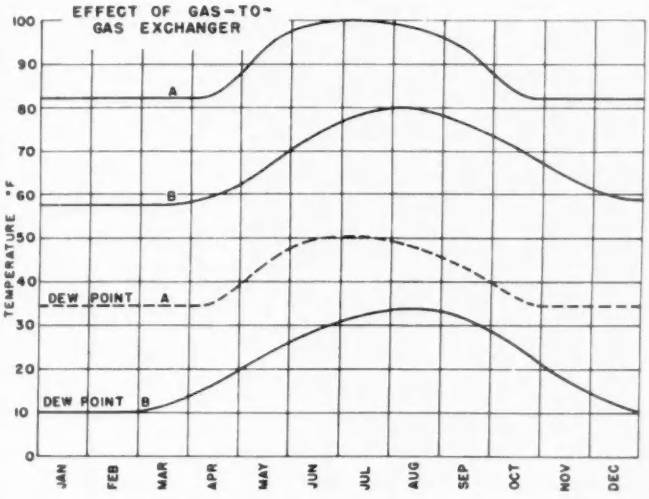


FIGURE 2. Top left.

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FIGURE 3. Top right.

★

FIGURE 4. Lower left.

head, the gas stream can be used to cool the still overhead, again eliminating the need for water cooling and pumping power.

Of course, under some arrangements, the use of gas cooling serves merely to transfer a heat load from one service or one stream to another. When the discharge gas from a station is cooled before leaving the station, the heat picked up by the gas in a suction gas oil cooler is added to the after-cooling load and finally dissipated in the gas after-cooler. This trading and collecting of heat quantities can often be used to advantage in simplifying piping layouts and equipment requirements. Also, in the case of a glycol dehydration plant located on the discharge side of a compressor station, a very definite advantage is obtained by installing a gas-to-gas heat exchanger upstream of the plant, thus effectively lowering the contact temperature and the dew point obtained. In such an installation, it is possible to lower the temperature of the discharge gas well below the temperature ordinarily attained in a cooling tower. As has been pointed out, the heat is merely transferred to another stream, but the lower temperature level is being utilized to obtain better dehydration. A more detailed analysis of this arrangement will be given later.

As to the general performance of gas exchangers, very satisfactory results have been experienced with such equipment now in use. Maintenance costs have been low and very little fouling has been encountered. Close agreement with design figures in all such installations has been obtained by checking field data.

The two most common forms of gas heat exchangers in use on the Panhandle Eastern System are the suction gas oil cooler and the gas-to-gas exchanger for dehydration plants. Both these types have been mentioned earlier, but it might be of interest to study them more intensively. Each has proven itself in operation and merits some analysis as to its effect.

First, let us study the gas-to-gas exchanger serving a glycol dehydration plant. This was the earliest application of gas cooling on the Panhandle System. Figure 1 shows the location of such an exchanger in a simplified plant flow sheet.

Gas from the field passes through the shell side of the exchangers and absorbs heat from the discharged gas. The discharge gas passing through the tubes is correspondingly cooled by this transfer and enters the contactors at a lower temperature. The advantage of having the contact process occur at a lower temperature is, of course, obvious. Figure 2 shows the effect of contact temperature on the equilibrium dew point for various concentrations of glycol solution. Assuming that the plant operates with a 95 percent solution to the contact towers, this chart can be re-plotted as shown in Figure 3.

Now, the dehydration of gas is largely of interest during the months of November through April. Without gas-to-gas exchangers, a plant might receive wet gas at about 85° F. during these months. This would be a fair figure based on the operation of an atmospheric cooling tower after-cooling the gas from the compressors. From the chart, the equilibrium dew point corresponding to 85° F. is 37° F. With gas-

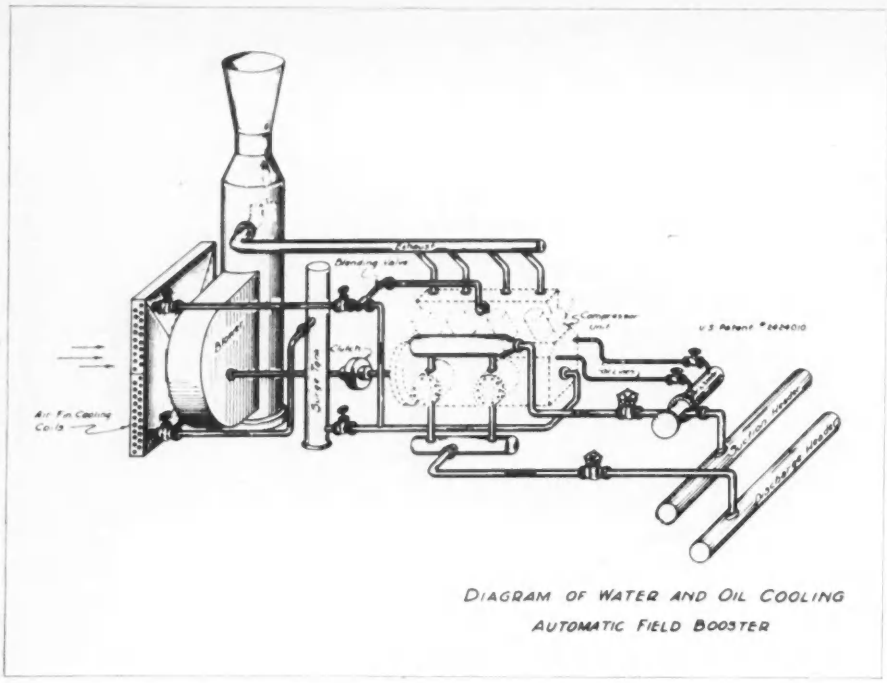


DIAGRAM OF WATER AND OIL COOLING
AUTOMATIC FIELD BOOSTER

FIGURE 5

to-gas exchangers, the contact temperature might easily be lowered to 70° F., which corresponds to a dew point of 24° F. Also, the exchangers serve to "iron out" the fluctuating diurnal temperature of the gas from a cooling tower, a commonly experienced phenomenon which is particularly troublesome during winter days when proper dehydration is critical. Notice, too, that the colder suction gas, the temperature of which follows the ground temperature exactly, gives the best cooling and the lowest contact temperature precisely when it is needed. The over-all process is largely relieved of the effects of daily weather and temperature changes, and gives dew point performance which is in keeping with the seasonal ground temperature condition. This is a very important advantage.

In the summer months, when hydrate formation is less likely to occur, the gas exchangers may be bypassed to prevent an unnecessary increase in the suction temperature; or, for that matter, it is likely that conditions might be such that the plant operator could shut down the dehydration unit completely.

At Panhandle Eastern's compressor station near Liberal, Kansas, a bank of these gas-to-gas exchangers has been in operation for several years. Figure 4 shows the year-round temperatures recorded at this setting. The upper line is the temperature of the wet gas to the exchangers; the second line shows the temperature of this gas as it leaves the exchangers. Below these lines are two dew point curves, the lower being the actual dew point obtained and the upper a calculated curve of the dew point that would have been obtained without the gas exchangers. This lowering of the dew point required no change in the operation of the glycol plant proper. Since gas-to-gas exchangers of this type need a minimum amount of attention, the increase in operation and maintenance charges occasioned by the addition of the exchanger bank was practically negligible.

A thorough, economic analysis of the desirability of adding gas exchangers to an existing installation can become a very complex proposition. Conditions at the particular plant and station under consideration have a great deal of bearing on the outcome of such a study. The general points to consider:

(a) The amount of cooling necessary to give the desired dew point.
(b) The temperature level at which this cooling must take place. (This is important because it may eliminate some other means of cooling the gas.)
(c) The effect of the exchangers on station horsepower and discharge gas cooling facilities—whether or not there is an excess of these facilities already installed.
(d) The availability and cost of such other equipment as might reasonably be substituted for gas-to-gas exchangers.
(e) Comparison of operating and maintenance costs of gas exchangers and any alternate proposals.
(f) Dependability and uniformity of service.
(g) Flexibility and simplicity of design.

As for new plant installations where there are no existing facilities, a further point must be investigated: namely, the comparative advantages of a glycol plant with gas-to-gas exchangers and a solid type plant. However, let us not digress too far in the direction of general dehydration process designs. The important concept to retain is that the nature of glycol dehydration is such that a plant of this type may very possibly be modified so as to give better performance simply by incorporating a low temperature level heat exchange between the wet gas to the plant and a cooler suction gas stream.

Next consider the use of the suction

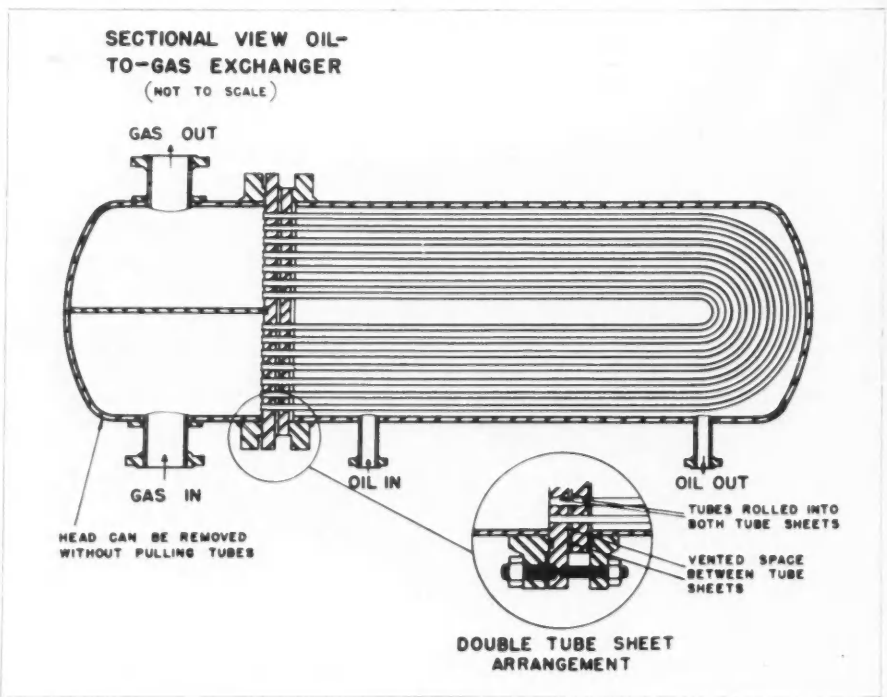
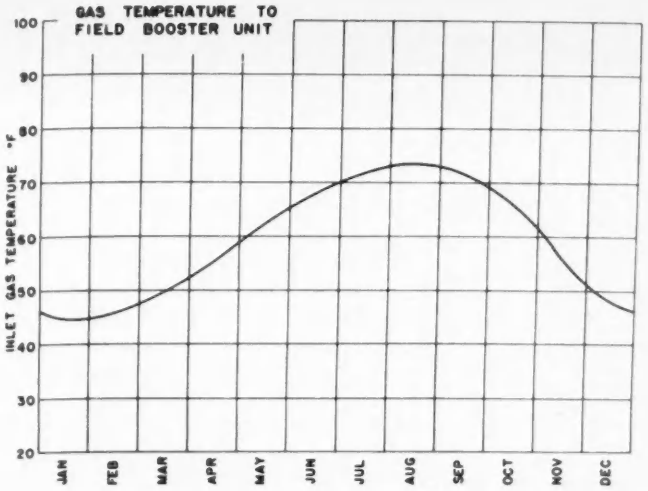


FIGURE 6



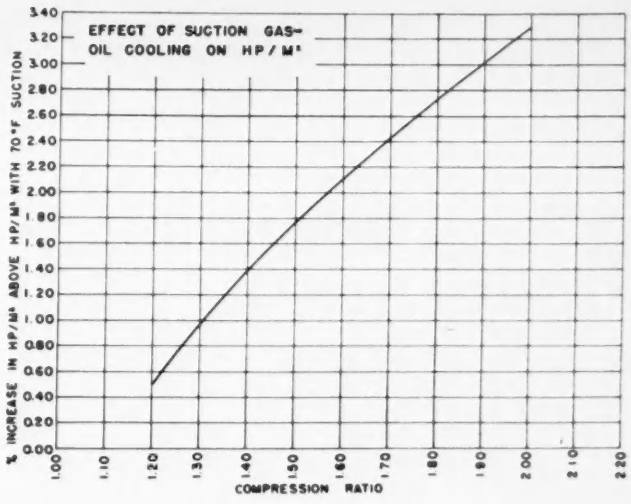


FIGURE 7. Top left.

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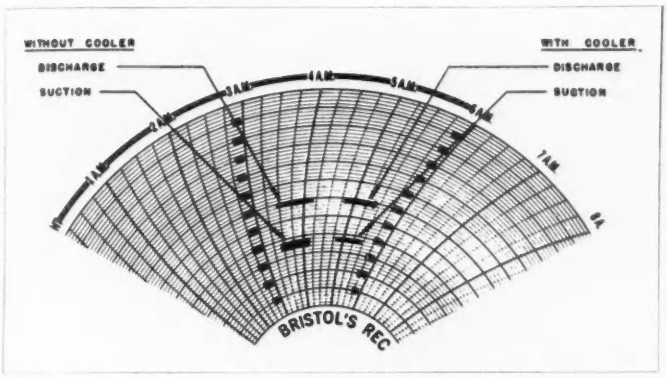

FIGURE 8 (lower left). Pulsation dampening effect of gas-oil cooler.

★

FIGURE 9. Top right.

gas as a coolant for the lube oil of a compressor engine. This form of oil cooling was first used on the compressor engines of a small field booster which was intended for automatic operation. Due to the scarcity of water and the fact that the installation was to be unattended, the booster unit was designed so as to eliminate all water cooling tower services. The jacket water heat load, a quantity too large to dump into the gas stream, was dissipated by air coils, and the oil heat load, quite small in the case of the particular engines used, was picked up by the cold gas flowing to the engines. Figure 5 shows the position of the cooler in the schematic layout for the unit.

Figure 6 shows a sectional view of the oil cooler used. A double tube sheet arrangement was used as a safety precaution to obviate the possibility of gas leaking into the oil stream through the tube joints. A blowout head and automatic shutoff controls protected the installation from damage in the event of a tube rupture. Provisions were made to trap and vent off any gas that might seep through pin-hole leaks into the oil, but this condition has never been encountered to date.

The question that arises, of course, is, "What about the effect on the horsepower requirements due to the higher suction temperature?" We know, from the basic theory of compression, that raising the temperature of a gas causes an increase in the horsepower required to pump a given quantity of the gas at a fixed compression ratio. The effect is undeniable, but the relative amplitude of the effect is the thing that is important. The amount by which the horsepower per million is increased is a deciding factor in determining the feasibility of such an installation. Referring to actual field data taken at the automatic station under discussion, a great deal of light can be thrown on this subject of temperature effect on horsepower.

The design basis for calculating the compressor horsepower assumed a 60° F. suction temperature. The actual suction temperatures encountered at the station are shown in Figure 7. For six months of the year, the field gas reaches the station at temperatures below the 60-degree design level. During this period, the true horsepower needed to handle the station's load is less than the design figure. Throughout the year, the station operates at a compression ratio which is essentially constant at 1.5, and, under such operation, the observed increase in gas temperature across the oil cooler is 2° F. Applying this temperature correction to the basic horsepower per million figure, the increase due to the presence of the suction gas oil cooler is 0.3 of 1 percent. For an installed horsepower of 300, this amounts to 0.9 horsepower. Even with the additional consideration of the pressure drop through the exchanger, which, incidentally, is slightly less than one pound, the horsepower chargeable to the oil cooler is about 1 horsepower for a 300 horsepower unit. At $210 per horsepower and $1000 for the exchanger, this would amount to $1210. Not only would comparable cooling facilities of a different type have been more expensive to install, but they would have also involved greater operating and maintenance expenses. The gas-oil cooler is ideally suited for automatic operation, whereas it is doubtful that a system using water or air as the cooling medium for the oil stream would lend itself to satisfactory unattended operation.

The same type of oil cooler has been applied to a main line station with comparable results. The cooler has 0.7 square feet of surface per horsepower being served, and the pressure drop on the gas side is 1.7 pounds per square inch at full capacity. Another interesting feature of this cooler is the dampening effect it exhibits on pulsations that would ordinarily exist in the station suction header. Figure 8 shows a portion of a pressure recorder chart. The recorded lines show the comparable amplitudes of pulsation obtained in the suction and discharge headers with and without a suction gas oil cooler. Notice the marked decrease in the degree of pulsation in the suction header when this cooler is used.

In the case of the main line station oil cooler, the temperature rise of the suc-

■ CONTINUED ON PAGE 206

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Simplified Loop Line

Gas Flow Equation

By J. I. MORRIS, Petroleum Engineer

WORKING FROM complex equations involving the use of fractional powers, the author develops general equations for computation of loop data in which only the squared power is used and where only relatively small, whole numbers are involved. This simplification greatly reduced possible error in computing basic data.

IN THE design of high pressure natural gas transmission systems, it is often desired to use a system consisting of parallel or looped lines. In design problems for this type of pipe line unit, the Weymouth flow equation or other gaseous flow equations may be the basis for calculations to determine unknown quantities necessary to complete the design of a given system. Two primary factors to be considered in the Weymouth equation are the diameter of the line in question and the length of this line. When this equation is applied to a loop system, the diameter and/or length functions are replaced by equivalent diameters and/or equivalent length values. The following equations are given in the USBM Monograph 6[1] to determine equivalent lengths and diameters.

$$L_1 = L_2 (d/d_2)^{16/3} \qquad (1a)$$

$$d_1 = d_2 \left(\frac{L_1}{L_2} \right)^{16/3} \qquad (1b)$$

where: L_1 = the equivalent length of any pipe of length L_2 and diameter d_2 in terms of diameter d_1.

d_1 = the equivalent diameter of any pipe of given diameter d_2 in terms of diameter d_1.

Inspection shows that these calculations necessitate raising given diameters and/or lengths to fractional powers, in this case the 16/3 power. In the case of the equivalent diameter formula, the resulting diameter or equivalent diameter to be applied in the flow equation is usually not that of a standard pipe size. Consequently, the standard pipe diameter and power table cannot be used.

In order to do away with uneven fractional powers in the calculation of equivalent diameters and/or lengths, several simplified equations were developed. These equations apply to simple and complex parallel pipe line systems having lines of equal diameter. The following assumptions were made in these derivations:

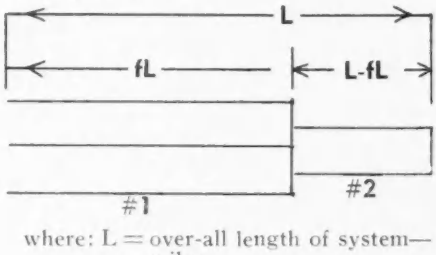
(1) Inlet and outlet pressure remain unchanged.

(2) The gravity of the gas remains constant.

(3) The flowing temperature remains constant.

(4) Temperature and pressure base remains unchanged.

The first case to be discussed is the determination of the equivalent length of a complex pipe line system consisting of two complex parallel pipe line systems. The system is shown in the following sketch:



where: L = over-all length of system—miles

L_e = equivalent length—miles

L_{e_1} = equivalent length of loop system #1

L_{e_2} = equivalent length of loop system #2

d = line diameter

d_e = equivalent diameter

d_{e_1} = equivalent diameter of loop system #1

d_{e_2} = equivalent diameter of loop system #2

f = fractional length of line being paralleled

N = number of lengths of pipe paralleling original length of pipe

N_1 = number of lengths of pipe in loop system #1

N_2 = number of lengths of pipe in loop system #2

Q = single line capacity

Qc = complex line capacity

The equivalent diameter (d_e) of a single line that has the same delivery capacity as that of the loop system is defined by the equation

$$d_e = [d_x^{8/3} + d_y^{8/3} + \ldots + d_n^{8/3}] \qquad (2)$$

For the system in question $d_x = d_y = d_z = d$. Equation (2) then becomes:

$$d_e^{8/3} = N d^{8/3} \qquad (3)$$

Substituting equation (3) in equation (1a) and simplifying the equivalent length for loop system #1 is

$$L_{e_1} = fL/N_1^2 \text{ miles of diameter d} \qquad (4)$$

and for loop system #2:

$$L_{e_2} = \frac{L - fL}{N_2^2} \text{ miles of diameter d} \qquad (4a)$$

the equivalent length for the total system:

$$L_{e_s} = L \left(\frac{f}{N_1^2} + \frac{1\text{-}f}{N_2^2} \right) \text{ miles of diameter d} \qquad (4b)$$

Equation (4) holds for any length of line paralleled by a number of lines of equal diameter. The equivalent length then is equal to the length of the original line paralleled divided by the square of the number of lines in the paralleling loop system. By assuming that an original 20-mile length of 12-inch line is to be paralleled by a second 12-inch line of equal length, the usefulness of this concept may be noted. The equivalent length is equal to 20/4 or five miles of a single 12-inch line. This value of L may then be substituted directly into a gaseous flow equation.

The second discussion deals with the determination of the delivery volume of gas transmitted through a complex pipe line system as compared to that volume carried by a single line of a diameter equal to the diameter of the lines in the complex system. The system and as-

sumptions are the same as those used in the derivation of equations (3) and (4). The equation for comparative delivery capacity in a single line and complex system is (1)

$$\frac{Q}{Q_1} = \left[\frac{Ln}{L}\right]^{1/2} \qquad (1c)$$

Combining equation (1c) with equation (4b) the relationship between delivery capacities is:

$$\left(\frac{Qc}{Q}\right)^2 = \frac{N_1^2 \times N_2^2}{N_2^2 f - N_1^2 f + N_1^2} \qquad (5)$$

In equation (5), all calculations pertaining to equivalent lengths or diameters have been removed. It is necessary only to know the number of loops in each section of the system. With this value known relative delivery capacities may be calculated.

The third set of derivations is associated with the determination of fractional lengths of line that must necessarily be looped with present lines when the present system delivery capacity is to be increased to a larger known delivery capacity. This is accomplished by solving equation (5) for "f" as follows:

$$f = \frac{N_1^2}{N_2^2 - N_1^2}\left(\frac{N_2^2 Q^2}{Qc^2} - 1\right) \qquad (6)$$

Again it will be noted that uneven fractional powers have been removed and equations involving equivalent lengths and diameters omitted.

These equations present an attempt to simplify the calculations concerned with the design and problems associated therewith of parallel gas pipe line systems. An effort has been made throughout to exclude the taking of diameters and lengths to uneven fractional powers in order to determine equivalent diameters and/or lengths of pipe.

These functions in general have been replaced by the factor of the number of loops in the parallel pipe line system. The factor "N" is taken to the second power in the majority of the equations. These are usually small whole numbers and are easily squared. Equations (4), (5) and (6) are general equations and may be adapted to any type of loop or parallel pipe line system.

The basic equations used in these derivations were taken from the data available in the USBM Monograph 6[1] by T. W. Johnson and W. B. Berwald. No changes were made in these basic data and assumptions set out in the report. The equations that have been derived and explained are primarily further developments of the data in Monograph 6 as applied to specific type parallel pipe line systems.

REFERENCE

[1] Johnson, T. W. and Berwald, W. B. "Flow of Natural Gas Through High-Pressure Transmission Lines." Monograph 6, U. S. Bureau of Mines, Department of the Interior, Washington, D. C.

Gas Heat Exchangers

■ CONTINUED FROM PAGE 203

tion gas is greater than the two degrees mentioned in the previous example. This is due to two factors: First, the type of engine used at the main line station has a much higher heat load per horsepower; and, second, the compression ratio at the latter station is somewhat higher, so that less gas is pumped per horsepower. The loss entailed by the elevated suction temperature can be plotted as a function of the compression ratio for a particular type of engine. Figure 9 shows such a plot; the ordinate of the chart is the percentage increase in the horsepower per million above the basic horsepower per million with a 70° F. suction temperature. It should be kept in mind that the curve is not valid for all engines, but depends on the oil heat load of the type being discussed. This oil heat load may range from less than 100 to as high as 750 Btu/hp-hr. in commercial types of compressor engines. The curve shown in the diagram is based on a figure of 625 Btu/hp-hr. which is a normal value for several common makes of engines.

Referring to the diagram, let us determine the effect of the gas-oil cooler in a conventional design. On a main line station of a system with a station spacing within the range normally encountered on gas transmission lines, it is common practice to select horsepower on the basis of a 70° F. suction temperature. This represents approximately the maximum condition encountered throughout the year. A normal compression ratio for the station may be taken as 1.4. From the curve, the increase in horsepower per million due to a gas-oil cooler would be 1.38 percent, but this loss would actually be realized from a design point of view only when the temperature of the gas from the cooler exceeded 70° F. In the case of a 1.4 ratio, this would correspond to a gas temperature of 60° F. to the cooler. If a weighted average were to be taken considering that part of the year when the incoming gas was below 60° F., the over-all loss would be about 0.6 to 0.7 of 1 percent. Not only is this figure quite small, but it is within the degree of accuracy to which the engines can be indicated on load tests. Thus, the loss involved becomes a matter largely of academic interest insofar as it affects the necessary performance of the engine.

Summing up this application of gas cooling, it can be said that definite advantages can be obtained under the proper conditions by rejecting the oil heat load to the gas stream. This is particularly true when the problem of water scarcity is involved.

A third use of gas cooling was made by Panhandle Eastern in connection with the design of a small automatic field desulfurization plant to be installed on a well in the Texas Panhandle field. The plant was to operate totally without power requirements. The major problem of circulating the amine solution was solved through the use of an alternately pressurized and vented dump tank, but the problem of interest to this discussion was the way in which the still overhead was to be cooled and condensed. Air cooling was considered as a possibility; natural convection and radiation to the atmosphere was one way of dissipating the heat. However, due to the wide seasonal variation in air temperature in that location, such a cooler would have to be designed for an extreme condition that might occur only for a short period of the year. When the air temperature dropped far below the maximum, sub-cooling and freezing difficulties could be expected, along with an unnecessary overload on the reboiler.

In contrast to the greatly varying air temperature, the temperature of the gas from the well was low and practically constant throughout the year. This design advantage suggested the use of gas cooling, a solution that offered the further advantage of a heat transfer rate corresponding to forced convection of the cooling medium. A small shell and tube exchanger was designed for the service and installed on top of the still. Several years of trouble-free operation have resulted; a side stream of sweet gas cools the still overhead and in turn rejects the heat to the ground through the pipe line.

The examples given here are only a few of the cases where the use of gas streams for cooling merit consideration. For instance, a possible application of this form of cooling has been suggested in conjunction with centrifugal compressor stations where a stream of seal oil must be cooled. Present trends in station and plant design make it necessary to re-evaluate the various solutions to the ordinary cooling problems. Progress is being made, both equipment-wise and cost-wise, towards the simplification of heat dissipation services. Naturally, there is no universally perfect answer to any general type of heat load rejection—each individual case involves its unique circumstances which determine the most suitable and proper process for that particular job. Water availability, power and operation costs, and dependability of service are just a few of the factors to be analyzed. Each design must be approached with an open mind and an awareness of the many possible methods available to the engineer from which he can devise a satisfactory process to suit the need at hand. It has been the intent of this discussion to present the various aspects of one such method, and to clarify, insofar as a general treatment can, the considerations involved in the use of gas streams for cooling.

PIPE LINE *Construction*

Projects Announced and Contracts Awarded

Products Lines

Great Lakes Pipe Line Company has announced that it is planning construction of a 206-mile, 12-inch line from Barnsdall, Okla., to Kansas City, Kansas.

Penn-York Pipe Line Company plans to build 410 miles of 10- to 14-inch line. Project will consist of two lines from Linden, N. J., and Marcus Hook, Penn., to Allentown, Penn., and a single to the Scranton-Wilkes-Barre area and north to Binghamton, Syracuse, and Rochester.

Natural Gas Lines

Commonwealth Natural Gas Corporation has FPC authorization to build a 200-mile line from Virginia Gas Transmission's 20-inch line in Greene County, Va., to serve natural gas markets in Norfolk, Richmond, and Newport News, Va. Construction must be started by July 1, 1950.

El Paso Natural Gas Company has applied to FPC for permission to lay a 34-mile line in Pinal and Maricopa counties, Ariz., and a 10-mile line in Phoenix for transfer to Central Arizona Light and Power Company.

Georgia Natural Gas Company has applied for authorization to build a 335-mile line from Southern Natural's line near Phoenix City, Ala., to Tallahassee, Fla.

New York State Natural Gas Corporation has been authorized to build 54 miles of 16-inch loop between Greene County compressor station and Westmoreland County compressor station.

Northwestern Utilities Limited plans 15 miles of 6- to 12-inch transmission line between its present Kinsella-Edmonton line and Fort Saskatchewan, Saskatchewan.

Northwestern Utilities Limited plans a 20-mile, 8-inch line from Devon, in Leduc field, to Edmonton.

Northwestern Utilities Limited plans gathering lines in Viking-Kinsella field, Saskatchewan, consisting of 11 miles of 16-inch, 10 miles of 4-inch, and 10 miles of various sizes.

Panhandle Eastern Pipe Line Company plans a 69-mile, 26-inch loop between Hugoton and Olpe, Kansas. Midwestern Constructors, Inc., Tulsa, to start in June.

Shell Pipe Line Corporation plans to build 20 miles of 8-inch line from Hope and Brushy Creek fields to Provident City, Texas.

South Central Alabama Natural Gas Company, Inc., has application before FPC for a 150-mile line to supply southeastern Alabama municipalities from Southern Natural's line in Elmore County, Ala.

Tennessee Gas Transmission Company has awarded contracts for the following loops on its main line: 90 miles of 30-inch from Many to West Monroe, La., will be started in June by Latex Construction Company, Houston; 33 miles of 30-inch from Jones, La., to the Mississippi River will be built by Latex Construction Company; 32 miles of 30-inch near Lake Village, Ark., to be started in June by Latex Construction Company; 90 miles of 30-inch from Drew to Holly Springs, Miss., to be started in June by Oklahoma Contracting Corporation, Austin.

Tennessee Gas Transmission Company plans a supply lateral in Louisiana consisting of a 54-mile, 12- and 16-inch line from Grand Chenier to Kinder, and a 95-mile, 20-inch line from Kinder to the main line at Natchitoches. Latex Construction Company, Houston, will build both lines.

Texas Gas Transmission Corporation has applied to FPC for authority to construct an 8-mile line from Lula, Miss., west across the Mississippi River. This line would supply gas to a new Arkansas Power & Light Company plant near Forrest City, Ark.

Transcontinental Gas Pipe Line Corporation has awarded contracts for part of the Texas section of its Texas-New York line as follows: Schedule B—153 miles of 24- and 26-inch line from Falfurrias to Edna. One hundred and eight miles of 24-inch will be started in September by H. B. Zachry Company, San Antonio. Contract has not been let for 26-inch. Schedule D—91.5 miles of 30-inch from Porters to the Sabine River will be started in July by Texas Southern Contracting Company, Fort Worth. Schedule E—81.5 miles of 30-inch from Sabine River to Eunice, La., will be started in July by Anderson Brothers Corporation, Houston.

United Fuel Gas Company plans to construct 32 miles of 10- and 20-inch line from Nitro to Clendenin, W. Va.

Projects Starting

Crude Oil Lines

Lakehead Pipe Line Company is building 360 miles of 18-inch line from Gretna, Manitoba, Canada, to Superior, Wis. Anderson Bros. Corporation started late in April.

Mid-Valley Pipeline Company has started work on three new sections of its Texas-Ohio line. Section 1—69 miles of 20-inch from Longview, Texas, to the Red River near Benton, La., was started in April by O. R. Burden Construction Corporation, Tulsa; 41 miles of 20-inch from Benton to Haynesville, La., was started in April by Latex Construction Company, Houston. Sections 3B & 4A—105 miles of 22-inch from Oakland, Miss., to Henderson, Tenn., were started in April by Houston Contracting Company, Houston. Sections 4B & 5A—105 miles of 22-inch from Henderson to Clarksville, Tenn., was started in March by Eastern Construction Company.

Mid-Valley Pipeline Company started preliminary work on 18 miles of 12-inch near Lake Providence, La. Latex Construction Company, Houston, contractor. This will complete the lateral from Delhi, La., to the main line at the Mississippi River.

Naph-Sol Refining Company started in March a 12-mile, 4-inch line from Paris field, Mecosta County, to Woodville, Newaygo County, Mich. L. R. Young Construction Company, Olney, Ill., contractor.

Stanolind Pipe Line Company started a 36-mile, 8-inch line from Stanolind's line into Post field, Garza County, to Cogdell pool, Kent County. Smith Contracting Corporation, Fort Worth, is contractor.

Products Lines

Great Lakes Pipe Line Company is building a 142-mile, 12-inch line from Atchison, Kansas, to Omaha, Neb. Started in April by Midwestern Constructors, Inc.

Salt Lake Pipe Line Company started in April a 120-mile, 8-inch line from Boise, Idaho, to Baker, Ore. Morrison-Knudsen Company, Inc., Macco Corporation, and Bechtel Corporation, San Francisco, contractors.

Natural Gas Lines

East Tennessee Natural Gas Company started in April a 380-mile line from TGT's main line at Lobelville to East Tennessee's recently-completed line at Oak Ridge, Tenn. N. A. Saigh Company, San Antonio, is building 150 miles of 12-inch from Tullahoma to Athens. Oman Construction Company, Nashville, is building 230 miles of 12-, 16-, and 22-inch from Lobelville to Tullahoma and from Athens to Oak Ridge.

Jersey Central Power & Light Company started in March a 39-mile, 10-inch line from TETCO's "Big Inch" at Bound Brook to Jersey Central's gas manufacturing plant at Long Branch, N. J. Construction Service Company, Bound Brook, and Proctor, Inc., Long Branch, are contractors.

Michigan-Wisconsin Pipe Line Company is building 197.5 miles of 8- to 14-inch main line from Milwaukee to Green Bay, Wis., with laterals to Fond du Lac and Sheboygan. G. G. Griffis Construction Company, Tulsa, started in April.

Northern Natural Gas Company started in March 221 miles of 26-inch loops on its main line between Skelleytown and Plattsmouth, Neb.; R. H. Fulton & Company, Lubbock, Texas, contractor. A 155-mile, 20-inch loop from Garden City to Bushton, Kansas, will be started in May by R. H. Fulton & Company.

Plains Natural Gas Company started in April 120 miles of 4- through 24-inch line in Hugoton field, Oklahoma. Arey-Phillips Construction Company, Pampa, Texas, contractor; Midwestern Constructors, Inc., Tulsa, engineers. This is part of a 282-mile gathering system, 78 miles of which has been completed.

Sun Oil Company, Natural Gas Department, is building 30 miles of 3- through 8-inch gathering system in

North Rincon, Starr County. Shanks & Eustace, Alice, Texas, started in April.

Tennessee Gas Transmission Company started 373 miles of 26-inch main line from Portsmouth, Ohio, to Buffalo, N. Y. H. C. Price Company, Bartlesville, Okla., started work in early April.

Tennessee Gas Transmission Company has started or is about to start the following main-line loops: 72 miles of 30-inch from Agua Dulce to Woodsboro and from Inez to El Campo, Texas, to be started in May by Oklahoma Contracting Corporation, Dallas; 102 miles of 30-inch at intervals between Selmer and Portland, Tenn., to be started in May by Morrison Construction Company, Inc., Austin; 97 miles of 30-inch from the Tennessee-Kentucky line to Lebanon, Ky., started in April by Morrison Construction Company; 40 miles of 30-inch from Lebanon to Lancaster, Tenn., started in April by Anderson Bros. Corporation, Houston; 68 miles of 26-inch in Rowan, Lewis, Carter, Boyd, and Greenup Counties, Ky., started in April by Anderson Bros. Corporation. Dravo Corporation has started preliminary work on compressor station #200 near Load, Ky.

Transcontinental Gas Pipe Line Corporation will start Schedule A of its line in May. Eighty miles of 10- to 14-inch line from Mercedes to Falfurrias, Texas, will be built by Massey Pipe Line Construction Company, Corpus Christi.

Transcontinental Gas Pipe Line Corporation will start work in May on four gathering laterals in Texas: 58 miles of 4- to 14-inch in the El Campo area will be built by T. & R. Construction Company, Houston; 98 miles of 6- to 14-inch in the Wharton area by Altgelt Construction Company, Corpus Christi; 38 miles of 4- to 8-inch in the Sinton area by Shanks & Eustace, Inc., Alice, Texas; and 61 miles of 6- to 10-inch in the Dix area by Victoria Oil Field Maintenance Company, Victoria, Texas.

Transcontinental Gas Pipe Line Corporation will build a 50-mile, 18- to 20-inch gathering lateral from Jennings to Crowley, La. O. R. Burden Construction Corporation, Tulsa, to start in May. Latex Construction Company, Houston, started in April one spread of an 85-mile, 4- to 14-inch gathering system in southern Louisiana.

Projects Completed

Products Lines

Great Lakes Pipe Line Company has almost completed its 12-inch line from Tulsa to St. Paul. Two hundred and thirty-six miles, from Tulsa to Kansas City, Mo., were finished in March by Pacific Pipe Line & Engineers, Ltd., Los Angeles; 190 miles from Kansas City to Des Moines were finished in April by Trojan Construction Company, Inc., Oklahoma City, Brodie Construction Company, Amarillo, Texas, and R. H. Fulton & Company, Lubbock, Texas; 112 miles from Des Moines to Mason City, Iowa, were completed in March by O. R. Burden Construction Corporation, Tulsa, and A. C. Holder Construction Company, Tulsa; 125 miles from Mason City to St. Paul will be completed in early May by A. C. Holder Construction Company and Sheehan Pipe Line Construction Company, Tulsa.

Great Lakes Pipe Line Company completed in March its 54-mile, 12-inch line from Ponca City to Barnsdall, Okla. A. C. Holder Construction Company, Tulsa, contractor.

Natural Gas Lines

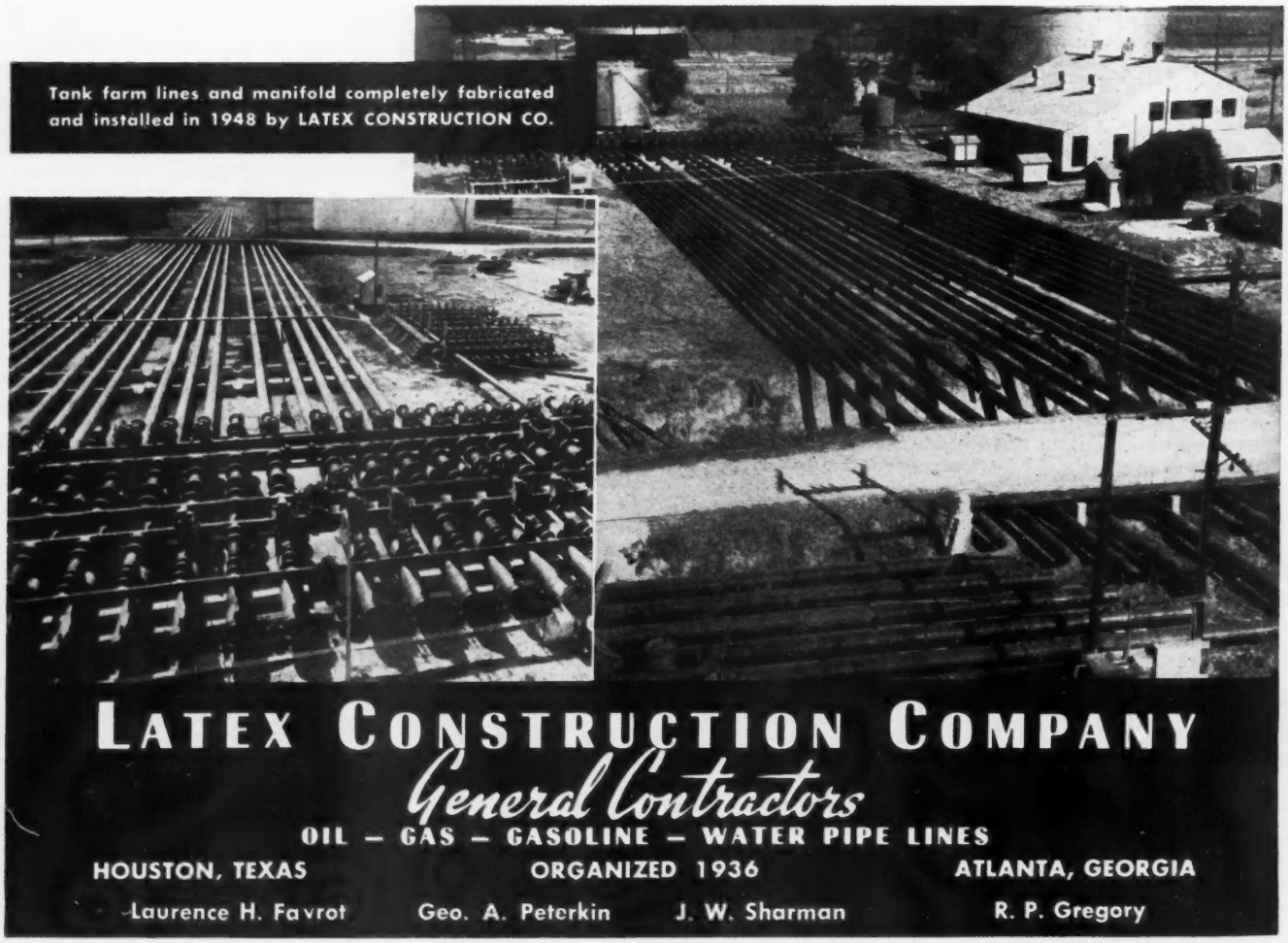
Cities Service Gas Company completed in April 50 miles of 4- to 10-inch line in Grant and Stanton Counties, Kansas. J. E. Carlson & Sons, Pampa, Texas, contractor.

Delaware Power and Light Company completed in April 10 miles of 12-inch from the Delaware-Pennsylvania line to Wilmington. George & Lynch, Wilmington, contractor.

Michigan Gas & Electric Company built in April a 10-mile, 6-inch line from Michigan-Wisconsin's 22-inch line to Holland, Mich. Somerville Construction Company, Ada, Mich., completed April 15.

Tennessee Gas Transmission Company will complete in May 32 miles of 26-inch from Premont to Agua Dulce, Texas. Sheppard & Geiger Construction Company, Corpus Christi, contractor.

Texas Eastern Transmission Corporation completed in April a 33-mile, 20-inch line from Beaumont to Hankamer, Texas. Associated Pipe Line Contractors, Inc., Houston, contractor.


Tank farm lines and manifold completely fabricated and installed in 1948 by LATEX CONSTRUCTION CO.
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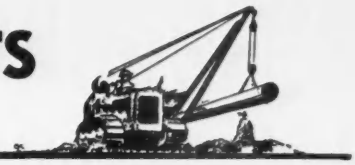
PIPE LINE HINTS



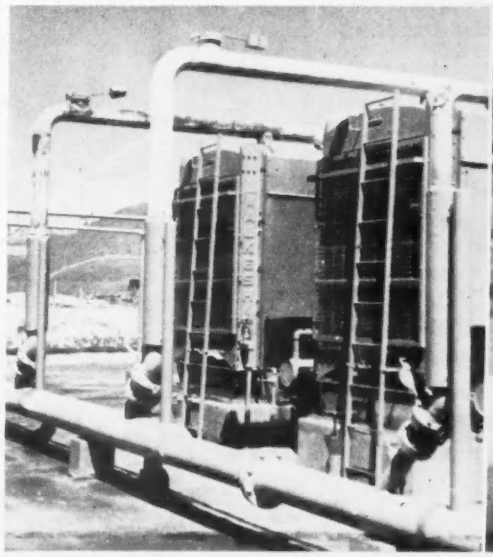
$10 is paid for each illustrated acceptable contribution. Mail to The Editor, WORLD OIL, P. O. Box 2608, Houston 1, Texas

HOW TO—Manifold Engine Exhaust Lines

Reducing engine noise and conveying engine exhaust gases away from the pump battery is accomplished in an efficient manner by this unusual exhaust pipe arrangement. Engines are mounted side by side with the exhaust lines leading overhead and to one side of the radiators.

A single line handling the exhaust from all engines is supported off the ground about ten inches by concrete blocks. This line is made in flanged sections and the line is enlarged in size toward the open end. Each exhaust line from the engines connects to the horizontal line by means of a vertical section 6 or 7 feet long. These vertical sections are connected through a flexible bellows-type expansion joint into the horizontal line at a 45-degree angle. The vertical section is supported by a short upright which is anchored to a sheath wrapped around the vertical exhaust lines. In this manner, the expansion joint can move freely to compensate for vibrations and temperature differences.

An opening is made on the top side of the exhaust line near the right angle bend as shown. This is a ground flanged joint with a matching hinged cover which is counterweighted to remain closed. In the event of a back-fire, the sudden surge of pressure in the line opens the counterweighted cover and exhausts into the atmosphere.



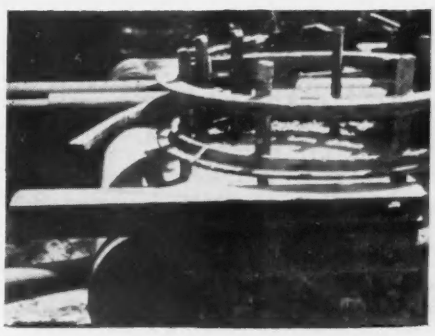
The expansion joint is fixed into the line on the upper end with two winged nuts which can be quickly unscrewed. Between these flange faces is fitted a "spectacle" plate, one end opened and the other solid. During operation of an engine, the open end of the spectacle plate is inserted between the flange faces. When the engine is shut down for repairs, the blanked end is bolted in place to seal off the exhaust line.

This exhaust line arrangement provides for injecting a water spray into the exhaust gas stream. A closeup of the expansion joint and the water injection line are shown at right. A small needle valve regulates the amount of water flowing through a one-fourth-inch copper tube connected to the 45-degree angle pipe welded to the horizontal line. This spray has the effect not only of extinguishing any back fire explosion but also of cooling the exhaust gases and thereby reducing the volume of exhaust to be handled by the larger line.

HOW TO—Equip Welding Truck With Anvil

A short section of scrap railroad rail, welded along one side member of the welding truck bed frame, is allowed to extend over the rear cross member 8 or 10 inches, the section resting on the truck bed being tack-welded at intervals to retain it firmly in place.

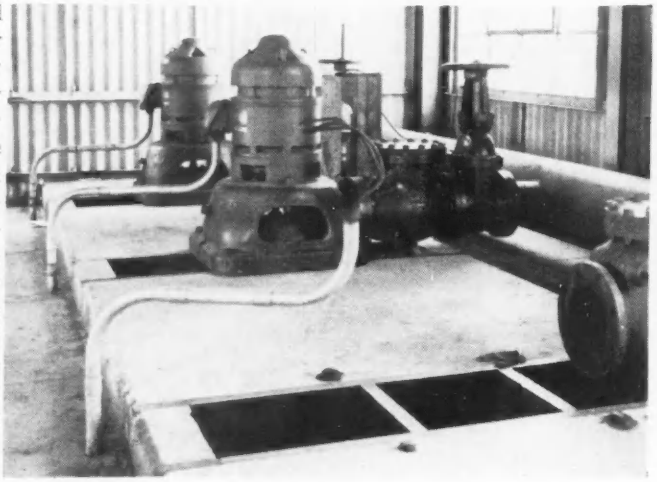
The extended portion of the rail serves as an anvil for riveting jobs, and also provides a base to which a small pipe vise can be readily clamped. The fish-plate bolt holes in the other end of the short



piece of rail also serve as hickey when pipe is to be bent, and serve as anchorage when a snatch block is to be used for winching a load into position.

The rail is out of the way of loads normally carried on the truck, and, being welded in place, cannot work loose. With the T-head down, a flat area wide enough for laying out small work is made handy, and the welded can tack work together there without requiring a cleared space on the timbered area of the truck bed.

HOW TO—Construct Flexible Water Pump Mounting



Where pumps used for circulating water over a cooling tower are mounted directly over the flume or trench in which the water returns from the tower, a semi-flexible mounting allows assembly of the units in the water system, as well as subsequent removal of any portion, to be carried out without disturbing adjacent equipment.

Instead of spacing the supporting channel beams so as to take the bolt-spacing of the pump base, the beams are set within those dimensions, and the bolts which mount the pump are carried in holes cored through the concrete decking of the flume. The holes are made larger than the bolts, so that the entire pump unit can be shifted over a tolerance of an inch or more without doing more than loosen the nuts at the pump base.

The slack thus provided by the pump mounting allows sufficient space to be introduced between pump body and check valve, or between that latter unit and the block gate, so that a new gasket can be introduced. Either valve unit can be lifted free and replaced simply by unbolting its flanges and loosening the pump mounting enough to allow that unit to be moved slightly, and without affecting either piping or electrical line-up otherwise. Conduit and flexible leads to the pump motor take up any variation occasioned by the shift.

HOW TO—Make Winch Line Hook for Handling Pipe

Where pipe is being handled with winch lines, a special hook may be made from a piece of sucker rod material, and the fabrication requires only a few minutes of the welder's time. Containing only one weld, the hook is made of a two-foot piece of three-quarter-inch rod. The hook is bent on one end with a short radius so that it fits into the end of a joint of pipe or over the winch line.

Approximately ten inches from the end of the hook, the rod is heated and

bent back on itself to form the eye for the winch line. Another bend is then made near the top and the end is welded to the outside of the hook, allowing plenty of space for a handhold.

The gap between the front and back of the hook where the winch line fits is filled with metal to keep the winch line away from the operator's hands. The large handle also makes a convenient place to tie the control line when pipe is being loaded a joint at a time from a railroad car.

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Like other Barrett* coal-tar enamels, Barrett* Millwrap Enamel is non-absorbent and impermeable by soil waters. Because of its stability when exposed to the surrounding electrolyte consisting of the entire soil composition, it retains its high electrical insulation value.

A permanent, strong, flexible shield protecting the pipe from corrosion, Barrett Millwrap Enamel is recommended for its ease of application and satisfactory performance. It combines the best service characteristics of the Barrett refined coal-tar pitches used in producing both regular and plasticized enamels. It does not crack at 0° F.; nor flow at 140° F.

Barrett Millwrap Enamel has demonstrated its ability to protect underground lines in extremely corrosive locations. It is also outstanding in its ability to withstand stockpile exposures before the pipe is laid, as well as exposure normal to pre-coated pipe protected at coating plants, yards, or railhead locations.

Memo: **FOR CORROSION ENGINEERS**

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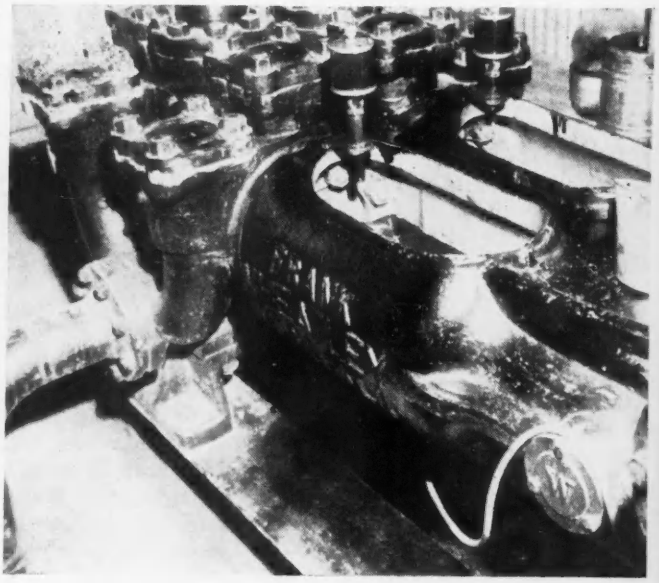
HOW TO—Lubricate Piston Rods



Where corrosive fluids are being pumped, the problem of keeping the piston rods lubricated and polished is a major one since they are exposed to both the corrosive liquid and the oxygen in the atmosphere. A method of keeping the power end of the piston rods lubricated is shown. Packing is placed around the rod between the main packing gland and the crank shaft, and the space is filled with a good grade of lubricating oil.

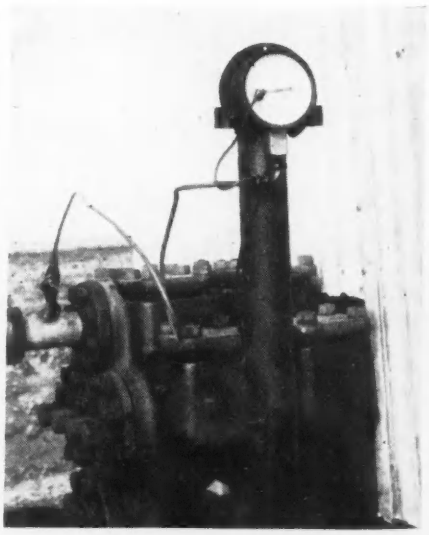
The overflow line shown at the lower right is made of half-inch copper tubing and is looped over a bearing cap so as to maintain the proper level in the piston rod case. This line connects to the bottom of the case and leads to the sump pit. When the pump is used to handle salt water, the leakage collects in the bottom and is overflowed through the line and only good lubricant is held against the rod. Sight feed lubricators maintain the level in the box sufficient to keep the rods flooded at all times.

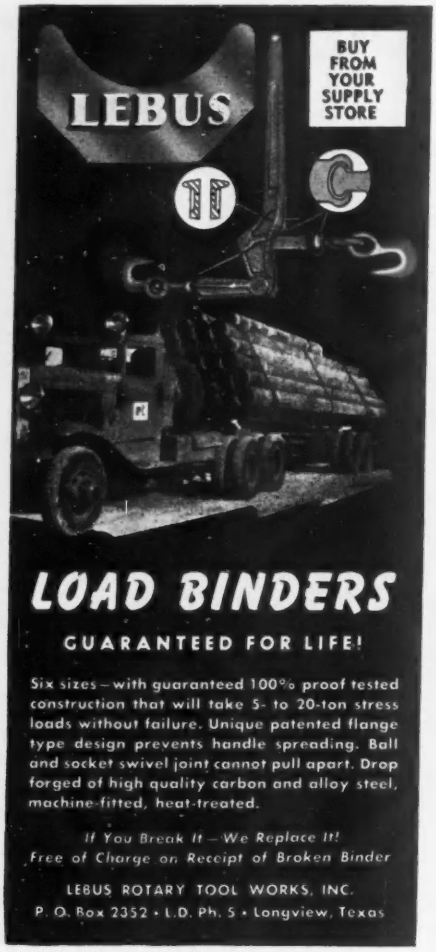
HOW TO—Provide Safety Shutoff

To prevent air from entering the lines and to avoid needless running of pumps after the tanks have been pumped out, an electrical cutoff switch may be installed as shown. A hole is drilled into the gauge glass at a point a few pounds below the working discharge pressure of the pump. A quarter-inch stove bolt is inserted in the hole so that it will make connection with the needle of the indicating gauge when the pressure falls to that point (100 pounds in the illustration).

The other end of the wire leading from the gauge connects with the low tension circuit of the magneto of the pumping engine. When the tank is pumped out, the pen falls against the connection in the gauge glass and grounds out the magneto.

The gauge is mounted on a stand made of a long four-inch nipple and the discharge pressure is connected to the gauge with quarter-inch copper tubing, thus the vibration of the pump does not cause the needle to touch the ground connection unless the discharge pressure falls. This arrangement has been in use for several months and no trouble has been encountered due to air in the oil line.

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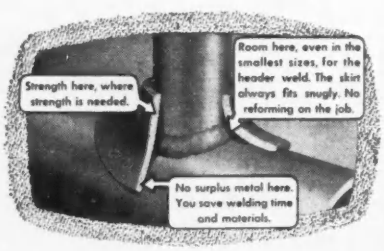
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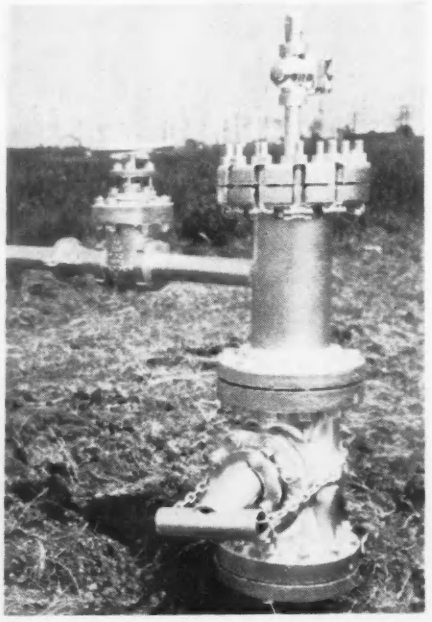
HOW TO—

Retain Flange Bolts For Easy Handling



The flange sealing the end of the blow-down stub on a gas transmission line is only infrequently removed for purging the section of the line controlled by it and the accompanying block gates, but it is important that the vent be closed as soon as possible after the venting is completed to reduce lost time in service.

One line uses companion flanges for this seal which are notched instead of being fitted with the usual bolt hole circle. To the under side of the lower flange is fitted a ringe which carries pairs of eyelets or stirrups. In these supports are placed the T-heads of the flange bolts—used in place of the usual hex-head bolts. When the nuts atop the upper flange are run up the thread enough to allow the T-bolt to be swung outward through its slot, the unit merely swings down out of the way, and is immediately available when the upper flange is replaced.

This method of mounting the blanking flange insures that all bolts will be at hand, complete with washer and nut, when the flange is set in place.

HOW TO—

Eliminate Hazard in Heavy Tire Repairs

A heavy-duty tire holding frame has proven its worth by preventing a serious accident in a truck maintenance shop. While inflating a 750 x 20 heavy-duty truck tire nestled in the holding frame, the keeper or lock rim sprung out and was thrown against the heavy pipe framework, causing a bad dent. Had

Courtesy *The Stanocolan*

the tire-holding device not been used it is likely that the tire repairman would have suffered a serious injury.

The tire-holding device was constructed of two- and three-inch pipe welded in two rectangular frames supported by angular braces of plate steel. Two cross pieces on the floor at either end of the device hold the two frames together. Angle iron welded to one end of these cross pieces makes it possible to adjust the distance between frames so that any size heavy-duty tire can be accommodated.

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Cuba's Oil Outlook

By J. E. KASTROP
Gulf Coast District Editor

POSSIBLY IN NO OTHER oil province is the geology so complex as in Cuba. In spite of these conditions, oil was first found on the Island as far back as 1881, and it has been produced ever since. The need for more oil in Cuba has prompted a careful inspection of all geologic conditions, and the results of this latest survey are reported here. According to these findings, prospects are most promising.

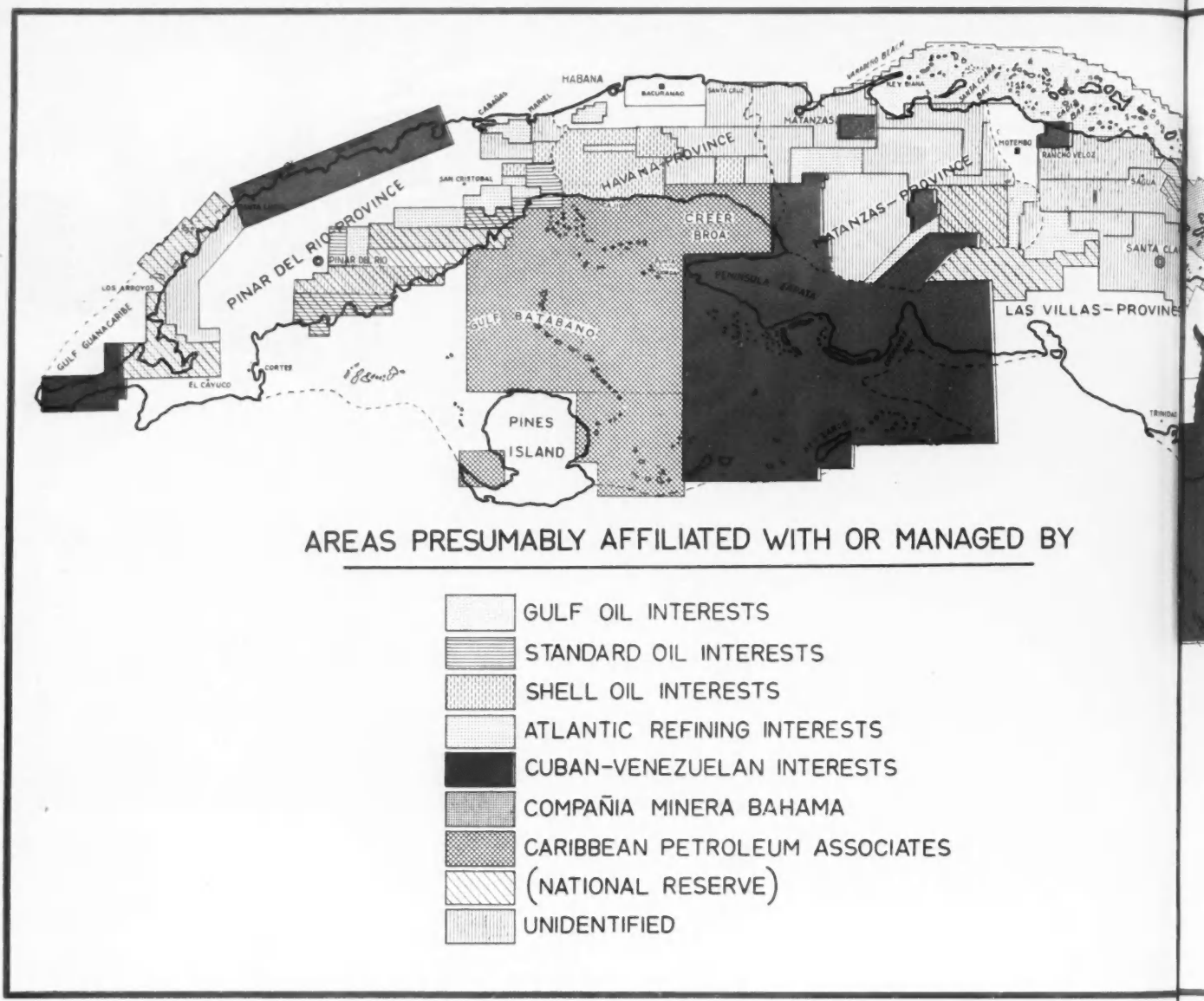
Photo courtesy CARTELES, Havana, Cuba.

Early last August, the Cuban Gulf Oil Company spudded its wildcat test in Cardenas Bay two miles from Cayo Diana. It was reported to have shows of oil and gas before drilling was halted at 5045 feet.

RECENT developments strengthen Cuba's hopes for a self-sustaining supply of petroleum.

The most promising comes from an entirely new concept of the island's complex geology. Intensive field investigations lasting for more than 16 months were recently completed by Oil Properties Consultants, Inc., of Pasadena, Calif., under the direction of Dr. René Engel. Findings of this geological survey, coupled with a thorough study of known geologic data, reveal the possibility of source beds and reservoir rocks in the sedimentary formations in the southern part of the island and coastal shelves.

A recent shot-in-the-arm for dwindling oil prospects came as a result of wildcat operations by Cuban Gulf Oil Company, a Gulf Oil Corporation subsidiary, which holds extensive concessions on submerged lands off Cuba's north coast, just east of Havana. Located two miles offshore in the shallow waters of Cardenas Bay and eight miles north of the Port of Cardenas, this wildcat was drilled to 5045 feet with heavy rotary equipment before operations were



halted. Details have not been announced, but unofficial reports are that oil and gas were encountered.

During the past year, increased activity developed in Cuban oil rights and concessions. Of considerable significance is the fact that approximately 80 percent of the land area and much of the adjacent submerged bays on the north and south are either covered by oil concessions already granted, applications pending for concessions, or land designated by the government as national reserves.

In addition to Gulf, other major oil interests represented in Cuba include Standard Oil Company (N. J.), Shell Oil Company, The Atlantic Refining Company, Cuban-Venezuelan Oil Voting Trust, Bahama Mining Company, and Caribbean Petroleum Associates.

New Reserves Needed

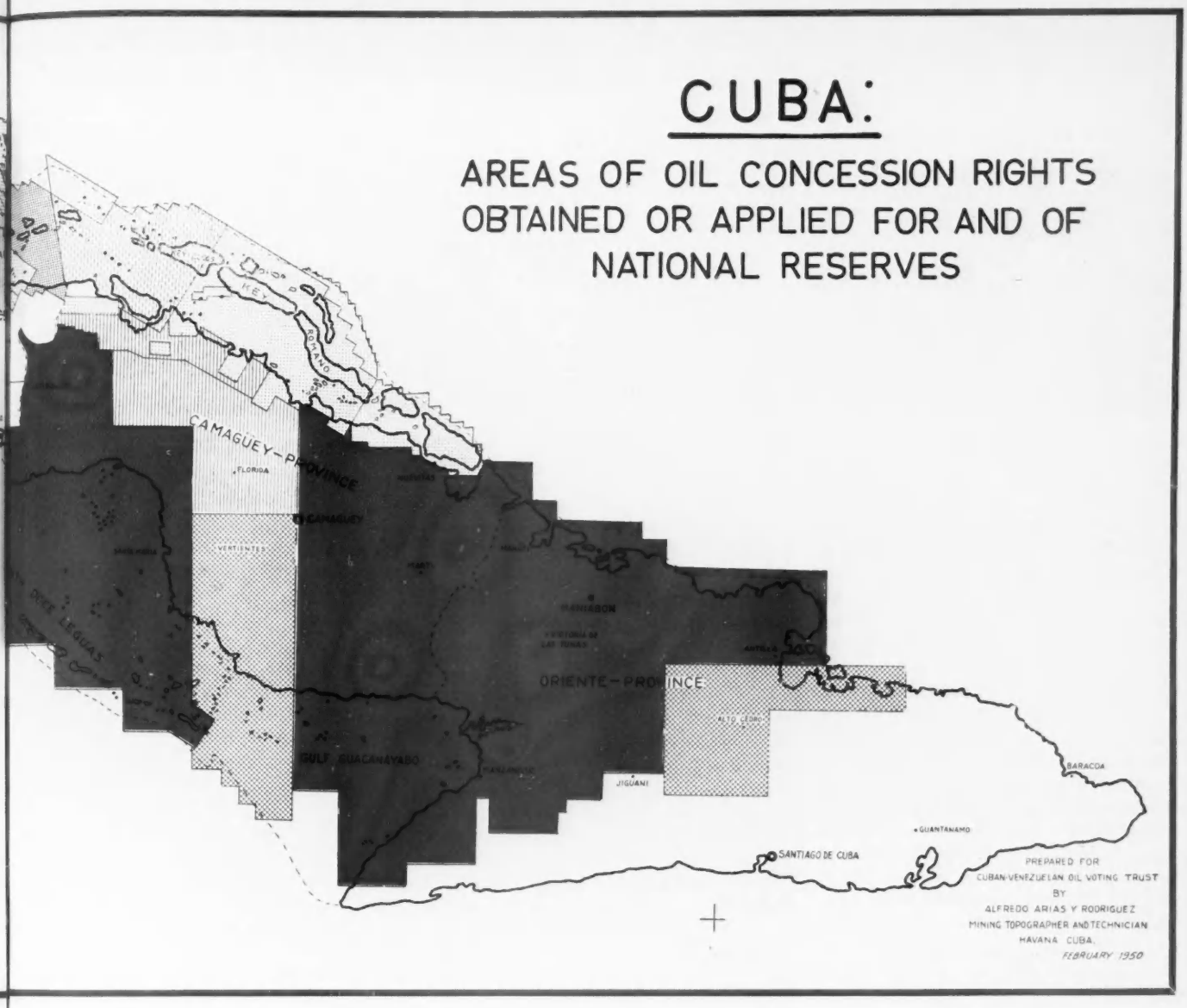
Cuba's economy has not been enhanced in recent years to any large extent by her oil industry. Mechanization of agriculture and industry, added to the growing demand of private and public motor transport, have brought about a demand for about 35,000 barrels of petroleum daily. Production from the island is probably less than 500 barrels per day. In 1949, Cuba's estimated oil production for the year was 172,400 barrels, whereas consumption was almost 13 million barrels of oil. Cuba's refining capacity is less than 5000 barrels daily, arising from the output of three small units. Most of the nation's petroleum requirements are supplied by the U. S., Venezuela, the Dutch West Indies, and Mexico.

Results of the latest geological investigation made by Oil Properties Consultants provide new facts which, combined with a re-analysis of recorded information, indicate that the Cuban southern basins offer the greatest chance for finding important deposits of petroleum. Source rocks, reservoir rocks, cap rocks, structural traps, and probable depositional traps can be expected there, according to the findings of OPC.

The subsurface geology is extremely complex, and consists, in general, of north-south gravity faulting and tilting imposed upon older east-west trending folds and thrusts with their accompanying shears. Transverse folding is limited to regions that have suffered repeated complex deformations. There are several broad domes, and several anticlines show closure.

Cuban rocks are Pre-Jurassic metamorphics, Mesozoic, Tertiary, and Quaternary sediments, with acid and basic intrusives and extrusives of different ages. Several Jurassic, Cretaceous, Eocene and Oligocene sediments offer possible source rocks, and good reservoir rocks may be found in some Cretaceous to Miocene sediments and in some fractured igneous bodies.

The relation of Cuban geology to petroleum may be understood more clearly after a careful study of the long history



of sedimentary deposition interrupted by orogenic movements and igneous activity. Oil and gas seepages as well as asphalt deposits have been found in the organic-bearing rocks located in the most disturbed and recently eroded parts of the island. These areas are more readily deciphered, and have received the most attention in regards to geological-geophysical and drilling activity.

In contrast to a vast backlog of activity in these disturbed regions, comparatively little exploratory work has been done in the least disturbed regions of Cuba, viz., the western and eastern coastal plains with their monotonous cover of Tertiary and Recent sediments, and in the southern shallow submarine shelves and related basins. While it is more difficult to make exacting observations in these regions, there is sufficient geologic evidence from which broad synclines and anticlines can be discerned in large areas of long sedimentary history. Dr. Engel has recommended that these structures should be investigated more thoroughly by detailed geological and geophysical methods. In that region, probably more than anywhere in Cuba, he reports, may be expected an abundance of organic source materials, diversity of sedimentation giving porous sands and probable reservoirs with possible depositional traps at unconformities. There are thick Upper Tertiary marl sections which would serve as cap rock material.

In concluding his report on Cuban oil geology, Dr. Engel writes, "It is logical to infer from evidence at hand that the Cuban southern basins offer the greatest chance of finding unfissured anticlines still containing important petroleum deposits."

Oil Fields of Cuba

Production of petroleum in Cuba has come from only three fields: the Motembo field about 17 miles northeast of Colon in Las Villas Province; the Bacuranao field some 12 miles east of Havana in Havana Province; and the Jarahueca field about ten miles north of Cabaiguan, also in Las Villas Province. Of the three, Motembo and Bacuranao are practically non-productive, and Jarahueca is the only remaining major producing field in Cuba. Its daily production is officially reported as about 430 barrels, but may be somewhat higher.

Since its discovery in October, 1943, Jarahueca produced a cumulative total as of January 1, 1950, of approximately 792,000 barrels of 38-degree API gravity crude. Of about 90 wells drilled to an average depth of 1200 feet, approximately 20 were producing at the beginning of the year. The producing zone is in fractured igneous basic rock: peridotite, altered to serpentine.

The oldest and so far the most productive field (although practically closed in at this writing) is the Motembo. One of the most unusual fields in the world, Motembo produced a light naphtha fuel

Looking northeast toward part of the Jarahueca field in Las Villas Province. Discovered in October, 1943, this field has produced about 800,000 barrels of oil, and is the major producing field in Cuba.

that could be mixed with other gasoline in the fuel tank of a gasoline engine. Published data on this field indicate that it was producing as early as 1881, although records of production extend only as far back as 1934. Known cumulative production as of January 1, 1950, was slightly more than 1 million barrels; however, it is likely that the field has produced perhaps 1.5 million barrels. Naphtha is obtained from the pockets in fractured serpentinized basic intrusives at depths ranging from 300 to 2000 feet. Approximately 1500 wells have been drilled in Motembo, and today only about 400 are producing very small volumes of naphtha (an average of 0.1 barrel per well per day).

Bacuranao Field

Now entirely inactive, Bacuranao field had produced almost 150,000 barrels by January 1, 1950. Records show drilling and production activity as early as 1914, although no work of importance was done until 1918. The field is along a fractured contact zone of upper Cretaceous limestone and diorite-gabbro. About 60 wells have been drilled in Bacuranao with cable tools down to producing depths of 200 to 2000 feet.

Liberal Petroleum Law

By 1938 it became apparent that Cuba needed a definite government policy to handle the increasing oil development. May 19, 1938, President Federico Laredo Brú signed into the law that country's practical approach to the exploration and exploitation of her petroleum resources. Known as Cuba's Mineral Fuel Law, the legislation encourages competition among domestic enterprises, and makes it relatively easy for foreign companies to obtain oil concessions. When compared to other countries which also retain all minerals in the name of the government, Cuba's oil law is a liberal one.

Little change has been made in the oil measure since it became law, and it has been operative since Cuba's oil boom in 1939 and the early 1940's, attesting its workability. The fact that in the past ten years a number of major companies have drilled for oil in Cuba is indicative in itself that its oil law is encouraging. In the October, 1949, issue of World Oil, Sigurd Scholle, vice president of Southeastern Oil, Inc., presented a clear discussion and analysis of Cuba's Mineral Fuel Law, and for that reason, no great detail will be given here.

Terms of the measure follow generally the type of law administered in many Latin American and South American countries. Concessions are limited in area, and are of the exploration-exploitation type. Applications are handled in each of the six provinces. The exploration concession endures for three years, after which it must be given up or converted to an exploitation concession. A well must then be commenced within two years after the exploitation concession is granted and must be completed by the end of the fifth year.

A 10 percent royalty is paid the government and a 1 percent royalty is paid the land owner. The exploitation concession extends for 30 years only, after which all property and improvements thereon revert to the government. However, the original concessionary is granted a 60-day option to continue operating the concession on the same terms which may have been tendered to the government by the highest bona fide bidder for the property.

The exploration concessions carry a yearly surface tax of 6 cents per acre, while exploitation concessions carry a surface tax as follows: 4 cents per acre per year for the first ten years; 8 cents per acre yearly for the next ten years; and 16 cents per acre annually for the last ten years. Pipe line facilities revert to the government after 30 years. Refineries are not affected by the law, except that oil refined in Cuba carries only a 9 percent royalty payment to the government instead of 10 percent.

Economic System Favorable

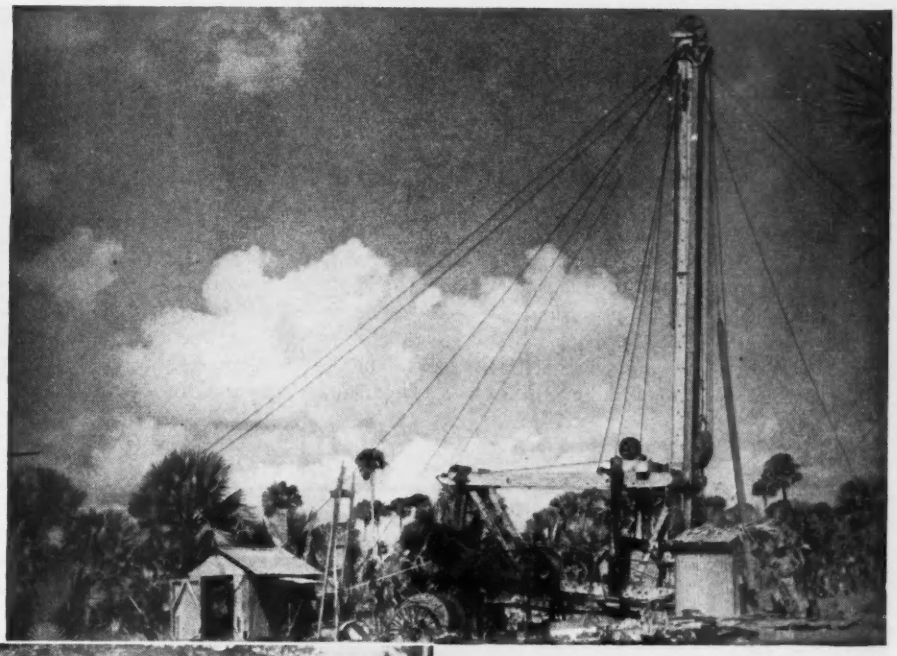
Long-range planning necessary for any oil development finds a favorable

Cuban Oil Production

Top line indicates the cumulative production through 1944. Figures for 1949 are estimates made by reliable sources on Cuban oil.

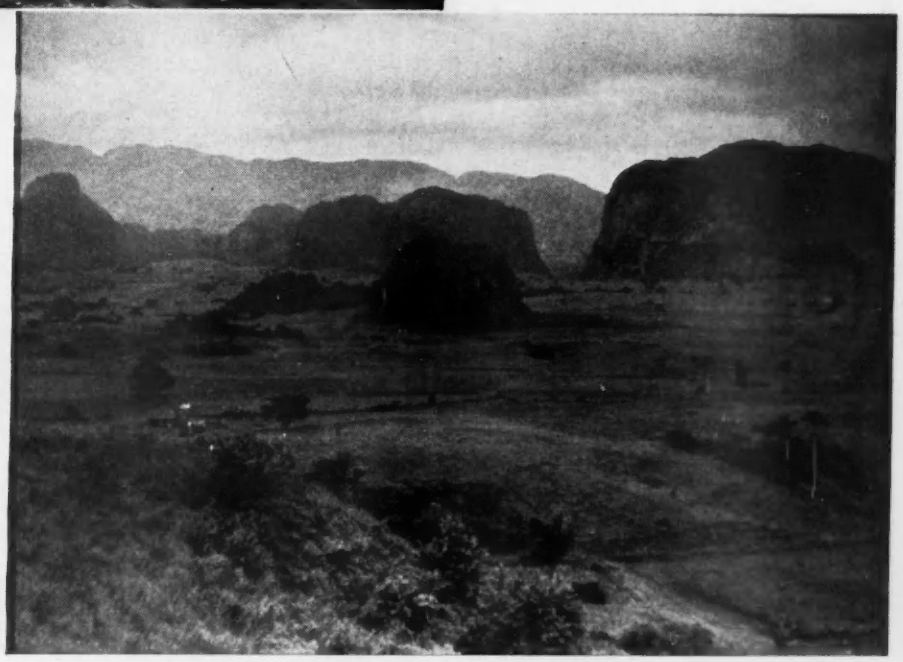
(U. S. BARRELS)

YEAR	Motembo (Discovered 1881)	Bacuranao (Discovered 1914)	Jarahueca (Discovered Oct., 1943)	Yearly Total	Cumulative	Daily Average
Cumulative through 1944	866,946	145,203	45,856	.....	1,058,005	....
(Yearly) 1945	65,500	700	105,700	171,900	1,229,905	471
1946	67,100	900	200,000	268,000	1,497,905	734
1947	60,000	900	220,000	280,900	1,778,805	767
1948	48,000	700	63,300	112,000	1,890,805	307
(Estimated) 1949	15,000	400	157,000	172,400	2,063,205	470
Cumulative by fields through 1949	1,122,546	148,803	791,856	.....	2,063,205	....



Typical cable tool operations in the Motembo field, Las Villas Province. Average production is about one-tenth barrel of naphtha per well per day.

Overturned fold in the Upper Cretaceous Cayetano formation near Concolacion del Norte, Pinar del Rio Province. Direction of folding compression was from the left of the illustration.



Looking north of Vinales valley in Pinar del Rio Province. Hill in the center is a mogote, a remnant of the Lower Cretaceous Vinales formation from the Pinar overthrust. The Sierra de los Organos is in the background. This view was taken from the "scar" of the overthrust just south of Vinales.

setting in Cuba's economy. The Cuban peso and the U. S. dollar have been at parity for the past 35 years. Both currencies are legal tender and are interchangeable. Pesos are freely converted into dollars for payments abroad, but a 2 percent export tax is levied on all dollars taken out of the country. That Cuba is on a sound financial basis can be evidenced by the fact that the total outstanding public debt of $94,658,500 is equivalent to less than $18 per capita compared to slightly less than $2000 public dept per capita in the U. S.

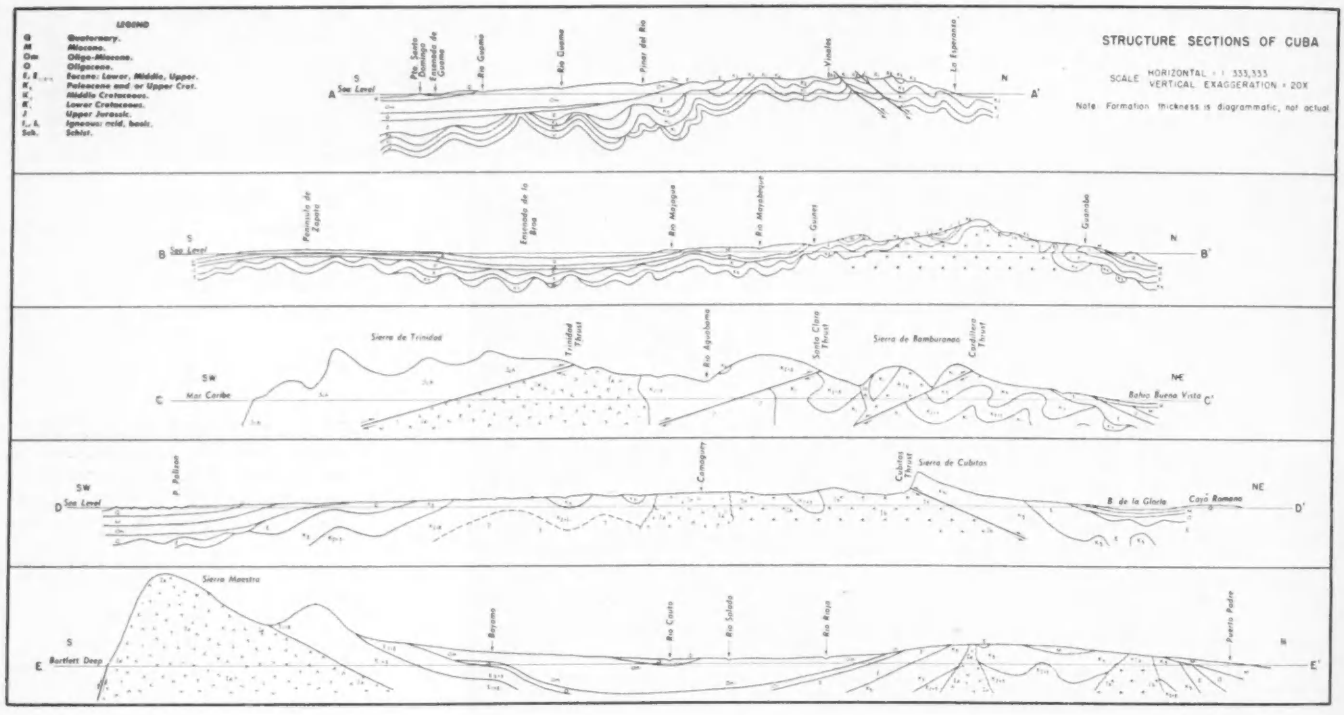
Investments in Cuban industries exceed $1,365,000,000, of which 75 percent is in sugar, the nation's backbone industry. Nearly 3000 enterprises in Cuba employ more than 1 million of the 5,200,000 population.

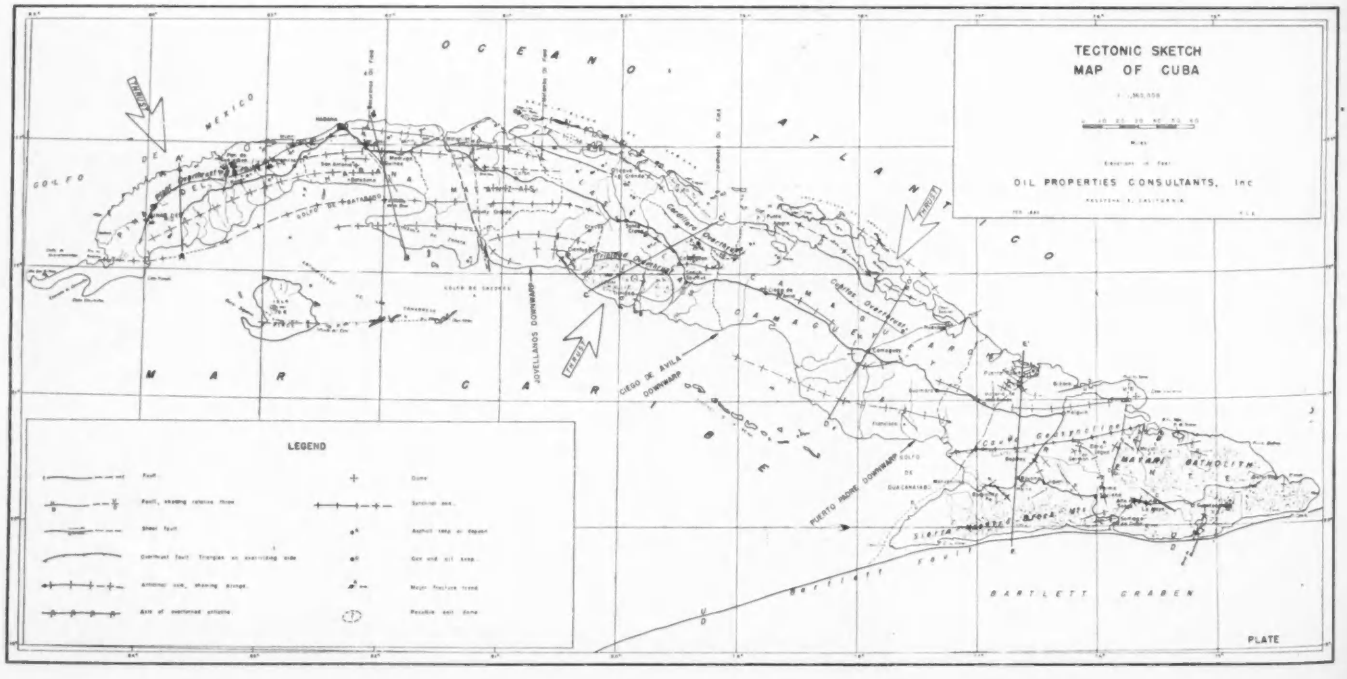
Labor-Management Relations

Labor-management relations in general are somewhat similar to those of the U. S., differing only in two main respects: labor relations are affected more by presidential decrees, and there is a closer bond between management and labor.

Because of the relative scarcity of jobs, the Cuban worker will go to extremes to protect the right to his job. This intense effort to protect workers has led to a controversial law which makes it difficult, if not impossible, to discharge an employe after he has been employed for six months. The Department of Labor acts as a judge in such cases where "cause" for dismissal must be shown. Cuba's President Prío Socarrás has advocated the creation of a labor code and of independent labor tribunals in order to curb abuses by labor and to attract capital for new industries.

The law relating to foreign workers is





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of direct concern to the oil industry. With the exception of drillers and toolpushers of foreign nationality who may be employed during the life of a concession, the law provides that after the tenth year and whenever possible, 85 percent of other technical personnel employed in drilling operations should be of Cuban nationality.

Taxes

The oil law expressly guarantees that production, transportation, and refining shall not be encumbered by other than general taxes, and that taxes and other obligations under the Oil Law shall not be increased during the life of the concession. Direct and indirect taxes, general and special, are lower in the aggregate than in the U. S. Tax exemptions to encourage development of natural resources are numerous, generous and of long range effect. The government may relieve new industries of taxes for five years.

The production, transportation and refining of petroleum in Cuba has been declared a public utility and is exempt from all special taxes, direct or indirect, national, provincial or municipal, now existing or which may be created during the life of the concession. Export of crude and refined products is exempt from taxes levied on most commodities.

On net corporate profits, the following tax schedule under the so-called "Tax Extension Law" applies:

Up to $100,000.....17 percent
$100,000 to $500,000....20.4 percent
$500,000 to $1,000,000...25.5 percent
Over $1,000,000.....34 percent

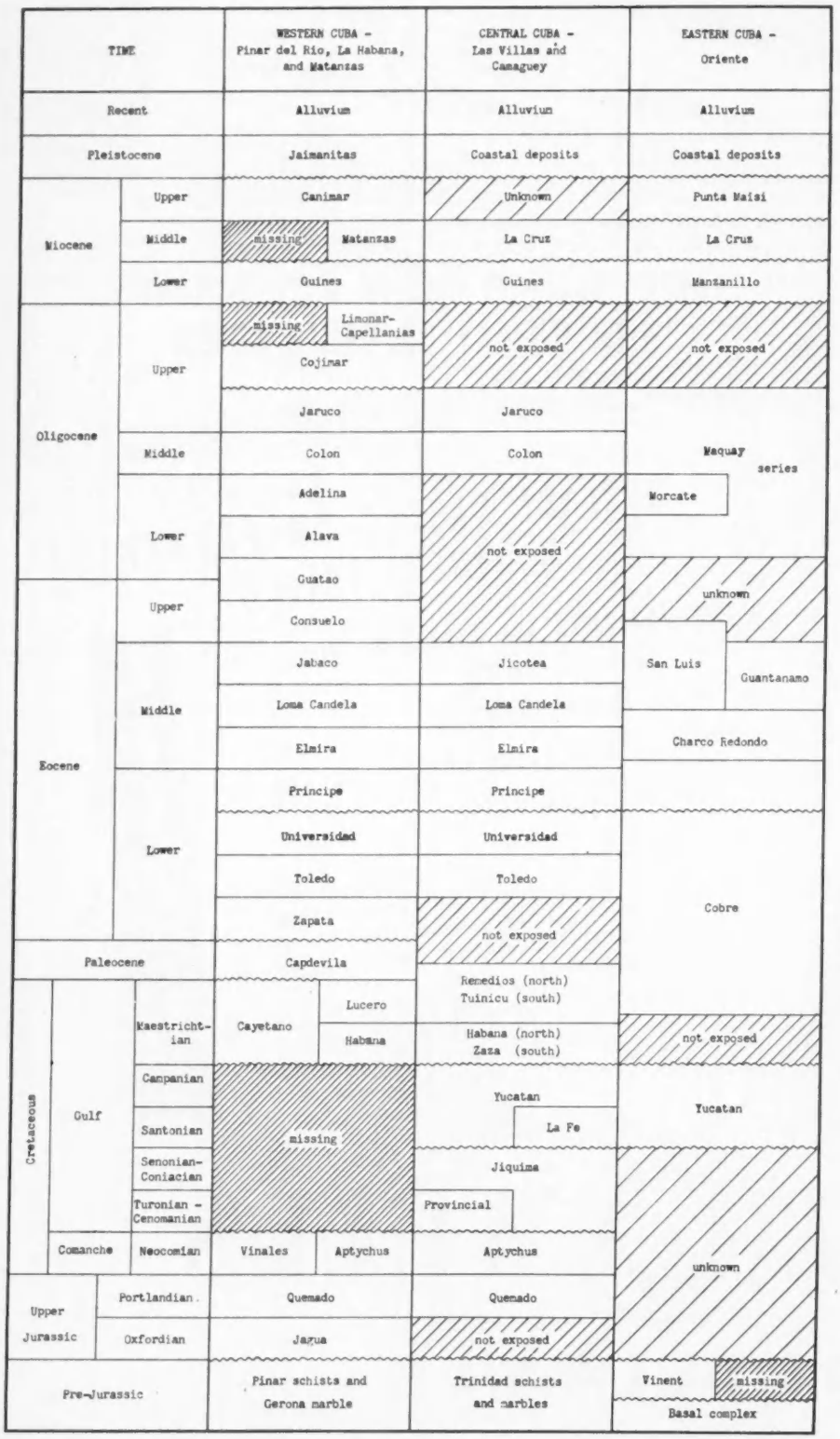
Computations of net profits follow the same general pattern used in the U. S. Greater latitude, however, is permitted in deductible items. Unlike amortization and depreciation, "depletion" of oil reserves is implied but not clearly defined by Cuban Tax measures. The law permits deductions for "the expenditure necessary to the productivity, protection and safeguarding of the property."

A National Stamp Tax, ranging from 1 cent on a $1 transaction to a maximum of $50 on amounts of $50,000 or more, is levied on most documents and invoices. Social Security and Maternity Taxes are withheld by the employer. The petroleum industry in Cuba is exempt from the 2.75 percent sales tax.

Role in Emergencies

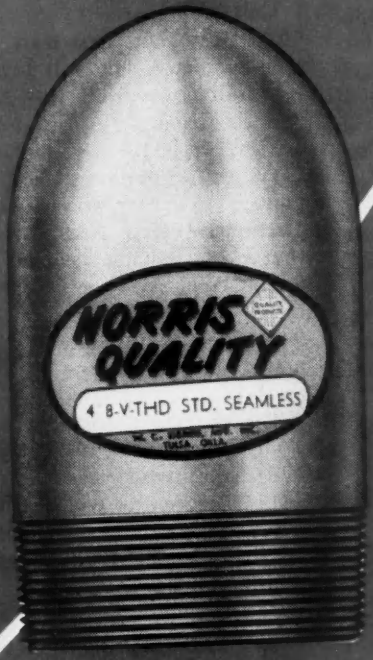
The desirability of large petroleum reserves in the Western Hemisphere can be put into focus by experiences in the recent world conflict and a review of current international disagreements. While the Western Hemisphere is now producing more oil than it consumes, a healthy oil reserve close at hand is always welcome. Considering its excellent ports, Cuba would be a lifeguard from a petroleum logistics standpoint in the event of another world war, provided of course, large reserves are developed there.

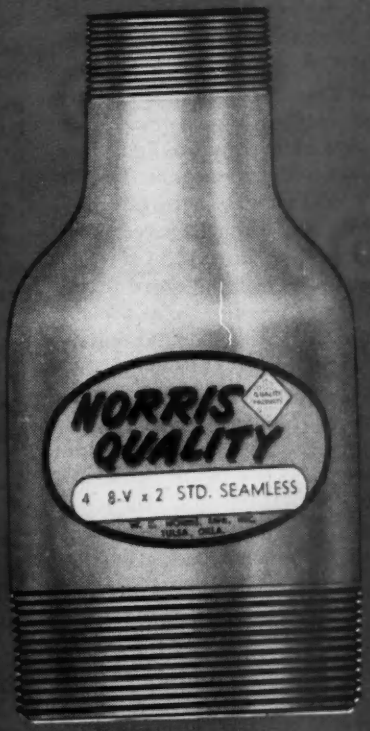
The outlook for a future Cuban oil industry is brightened by this new and most recent analysis of the island's geology which holds the secret to its petroleum resources. What the sediments to the south, the east and the west contain, only the drill will tell. Cuba's hope for a place in the Western oil world lies in the continued search for petroleum in the most favorable areas indicated by best scientific analysis.



Cuban Stratigraphic Column.

FITTINGS THAT *Fit*





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U. S. Firms to Enter *Tunisia*

By HENRY OZANNE
Eastern District Editor

A NEW AREA in North Africa for oil activities is being opened with the beginning of Tunisian operations by Gulf Exploration Company and the Dutch Shell Group, who have signed separate contracts with the French government for development rights covering extensive areas. Negotiations required two years, and less than a month after the contract was signed, Gulf was moving personnel and equipment into the new area.

GULF Exploration Company and the Dutch Shell Group have signed separate concession contracts with the French government for development rights covering extensive areas in Tunisia, North Africa, and both companies are independently pushing plans for immediate surveys. The concessions were signed March 11, more than two years after the beginning of negotiations with French officials; and in less than one month after the final approval, Gulf was moving two geological parties to Tunisia and an aerial magnetometer was on its way for prompt launching of an intensive exploration program. Gulf will conduct seismic studies later this year and expects to spud in its first test toward the latter part of 1951.

Both the new concession areas are sectored out of the original concession in Tunisia held by the Societe de'Etudes et de Recherches Petroliferes en Tunisie (SEREPT), a Tunisian state oil company in which the French government holds a 57.5 percent interest. Gulf and Shell's operations will be conducted through newly-established mixed companies. Gulf is associated in the enterprise with a SEREPT subsidiary, Societe des Recherches et de'Exploitation des Petroles en Tunisie (SEREPT, S. A.), the name of the joint operating company being Societe Nord Africaine des Petroles (SNAP).

SNAP has been formed with a capital of 1500 million French francs, contributed 65 percent by Gulf and 35 percent by SEREPT, S. A. Gulf is naming six of the nine members of SNAP's board of directors.

SNAP's concession area consists of 19,600 square kilometers comprising three component regions: (1) a rectangular east-west land block centering at Sfax on the east; (2) the island of Kerkenna; and (3) the island of Djerba. Shell's concession is north of this area with an eastern boundary along the Tunisian coast.

Terms of both contracts, it is understood, are identical, including the obligation of each of the mixed companies to spend the equivalent of $4 million in development work in a five-year period. The grants cover a 14-year exploration time with time extensions possible, but extension beyond the first five-year period carries the obligation for further expenditures. Cash payments are stipulated, based on a complicated index formula relating to living costs and basic industry indices. At the expiration of the exploration period, the operators can retain only 80 percent of the original area grant, and if the first grant is extended, this area is to be reduced to 64 percent of original size, and after another extension to half the original size. Selections of area to be retained are the operators' choice. If at the end of the exploration period, the operators have not made application for an exploitation concession, the contract lapses. If application is made, it is granted automatically.

99-Year Contract

The whole contract, including both exploration and exploitation stages, is for 99 years with possible extension of 15 years or more.

Royalty obligations are to be 10 percent of the oil or gas production, or the value of this volume as determined in the field. Tunisia has the right to call for a percentage of output up to 60 percent of the total for domestic consumption, provided that the royalty oil shall first be taken and counted toward the 60 percent volume.

The French government agreed on the contract terms with the companies more than a year ago, but the grant was held up in the French Parliament because of objection by leftist French parties. After the contract was cleared by the French Central government, it was approved locally by the Bey of Tunis.

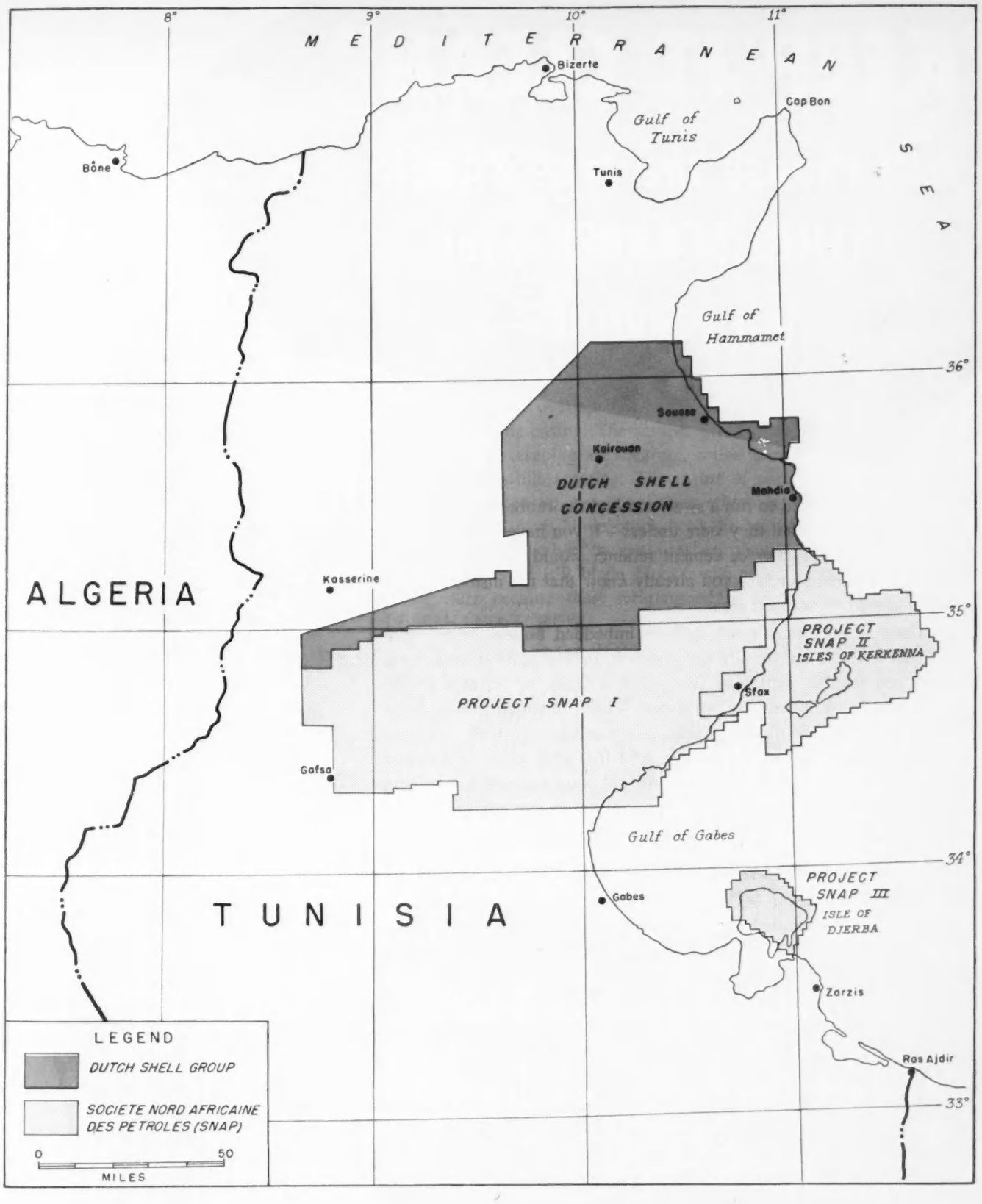
The Tunisian operations will mark a new area in North Africa for oil activity. Industry authorities estimate it will cost about $200 million to prospect the entire concession areas. The whole country is virtually wildcat region but thick sedimentary sections have long been favorably regarded by geologists. Drilling has been infrequent and shallow. When SEREPT itself was working, it kept two rigs in operation, one at Cap Bon and the other at El Haroun, and one deep wildcat was completed on the latter structure. This test was abandoned at 9500 feet.

Gulf is prepared to go to depths of 10,000 feet in its first tests. The flying magnetometer that will begin SNAP's exploration program was flown up to Tunisia from Johannesburg, South Africa. It is the DC-3 plane of Aero Service Corporation which lately was engaged in survey work in Mozambique, Portuguese East Africa, and prior to that in the Bahama Islands. Aero Service will conduct the aerial part of the Tunisian exploration program for SNAP. The plane is fully fitted and equipped now and flying crews and technical staff are proceeding to Tunisia.

The geological structure of Northern Tunisia consists mostly of complicated folds with intrusions of salt and gypsum beds. The central part is characterized by elongated anticlinal foldings, while in the southern part the sediments are only slightly folded.

The formations exposed in Northern Tunisia consist of a great thickness of marine and continental sediment from Triassic to Recent age. Tertiary marine formations are not present in Southern Tunisia. Marine Cretaceous formations are well developed and are present in between the northern and southern parts. The sediments show no appreciable metamorphism.

Exploratory drilling started in Tunisia in 1910 by the Carthage Oil Syndicate (British) and a number of shallow wells were drilled in the northern area.



Concession areas granted SNAP and the Dutch Shell Group.

Only one of these tests encountered oil and gas in commercial quantities. A well was drilled by French interests in 1926 at Cap Bon, 30 miles east of Tunis. Small shows of oil were found and intermittent flows of gas encountered.

SEREPT drilled seven wells in North Tunisia before World War II but only slight shows of oil were encountered.

Since the last war SEREPT has drilled several other deep tests, up to 10,000 feet, one of which was on Cap Bon structure, and the operators reported heavy gas flows and some light condensate in the Cretaceous. During 1949 this company completed another test well and also a dry hole, and was starting still another on Cap Bon.

"KEEP IT CLEAN"

Just choose the type BAKER CASING SCRAPER your job requires

If you have ever tried to run a swab and had the rubber cups so badly torn and damaged that they were useless – if you have ever hit a spot through which a packer or cement retainer would *not* run and had the slips set prematurely – you already *know* that the inside walls of casing should be scraped clean.

There is no longer need to have imbedded bullets, burrs from gun-shot holes, a hardened cement sheath, or any other obstructions, cause you trouble. Anything that projects from, or adheres to the important "working surface" of casing – even down to mill scale or rotary mud – can be quickly, easily, safely and economically removed from the inside wall of the casing. And this vital work of scraping can be done either while the rotary rig still is up and you are drilling out the cement shoe; or at any convenient time by running the scraper on tubing or a wire line for vertical removal of obstructions.

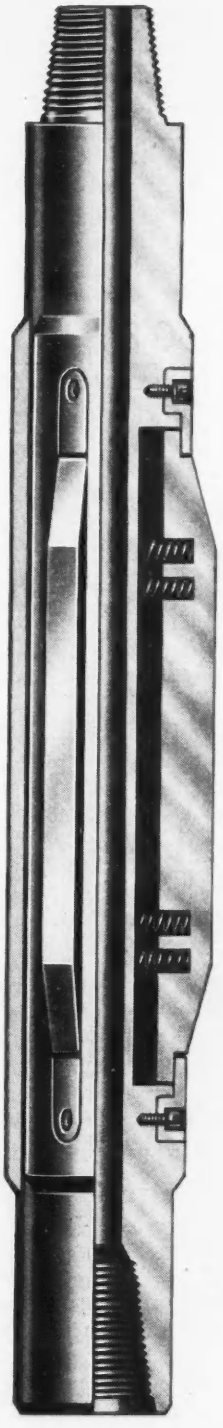
TWO TYPES OF BAKER CASING SCRAPERS MEET EVERY REQUIREMENT

The field-tested Baker MODEL "B" Casing Scraper (Product No. 620-B) is recommended for use when the rotary rig still is up and only hardened cement or a limited number of gun-shot burrs are to be removed. It is usually run just above the bit while drilling out cement, and will remove protruding burrs as well as the thin sheath of cement left even after the maximum gauge bit has been used for drilling out.

When there are several hundred gun-shot holes (with possible imbedded bullets); or if the hardened sheath of mud is to be removed from top to bottom of the well, the new Baker ROTO-VERT Casing Scraper (Product No. 620-C) is recommended. The ROTO-VERT can be run on drill pipe for successful vertical scraping of obstructions as it is being lowered in the hole, followed by rotation if difficult well conditions make rotation necessary or desirable; or it is run on tubing or a wire line for successful all-vertical scraping.

SCRAPING IS A VITAL PART OF WELL COMPLETION

Many operators consider that the use of a Baker Casing Scraper is a "must" in the completion of *every* new well, and after *every* gun-perforating job. They *know* that the inside wall of the casing is left smooth and "clean as a hound's tooth" ready to run a swab or testing



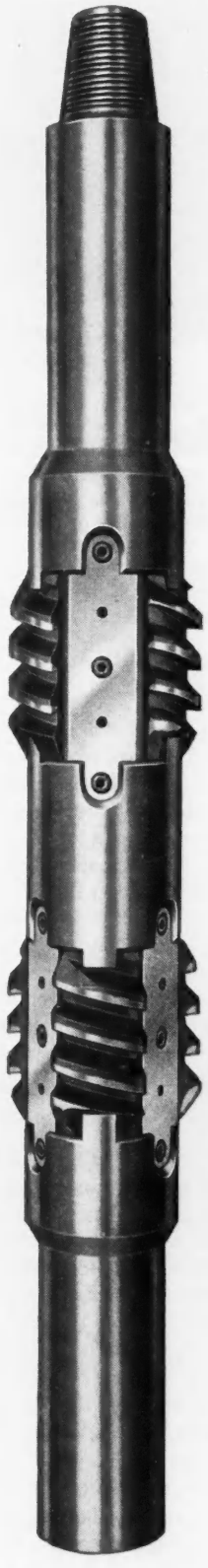
Baker MODEL "B" Casing Scraper
Product No. 620-B

tool with no trouble. They *know* that the tubing or liner can be run easily and safely, and that packers and cement retainers will run-in readily and seal-off perfectly against the clean, smooth inner surface of the casing. Not only is the well then ready for immediate completion, but it will be left with the "working surface" safe for all future down-hole work. Isn't the reasonable rental charge for a Baker Casing Scraper cheap insurance for leaving your well in perfect condition?

THE NEW BAKER ROTO-VERT SCRAPER IS POSITIVE AND SAFE

The strong, simple construction of this efficient scraper is evident from the illustration which shows the rugged body on which six blade blocks are mounted, and held in position by blade block retainers. These blade blocks are set in two horizontal rows in a staggered position so that the blades overlap and will scrape the full 360° surface of the inner wall of the casing. The scraper blades are cut on a helix angle and provide a scraping, or shearing, action both while moving down the hole and while rotating. The thrust of each blade block, when rotating, is taken by a driving block which is welded to the body. Springs behind each blade block hold the hard-faced scraper blades against the inner wall of the casing where they exert positive shearing action. ROTO-VERT blade blocks will never screw down past a casing burr because their scraping edges follow the contour of a LEFT-HAND SCREW.

Field reports on the ROTO-VERT Casing Scraper prove its efficiency when used as recommended for the removal of a large number of burrs from gun-shot holes, and possible bullets imbedded in the casing. A ROTO-VERT used on two consecutive jobs scraped a total of 1,548 perforation burrs WITH THE SAME SET OF BLADE BLOCKS, and the blades were still in usable condition. Further proof of the complete, clean removal of burrs was provided when the swab cups used in connection with washing the perforations in both wells, were found upon removal from the well, to be in good condition.



Baker ROTO-VERT Casing Scraper
Product No. 620-C

You'll always be glad you scraped the "working surface" of your casing

Descriptive literature is available on both types of Baker Casing Scrapers—or, better yet, ask the Baker representative in your area how you profit when you use a Baker Casing Scraper to "KEEP IT CLEAN."

BAKER OIL TOOLS, INC.
Houston • Los Angeles • New York

Streamlined Core-Handling

By GILBERT M. WILSON
Pacific Coast District Editor

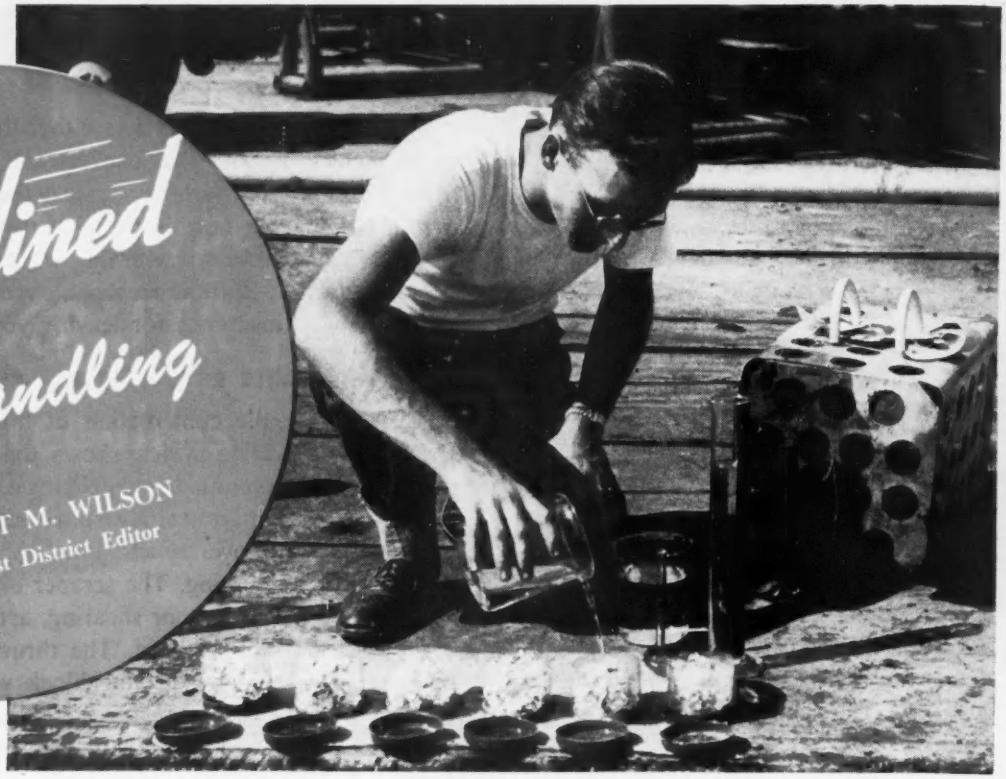


FIGURE 1. Core sections are wrapped in aluminum foil and placed in individual, special cylindrical plastic containers. A clear, synthetic liquid plastic resin then is poured around and completely over the sample. This resin, poured at atmospheric temperature, sets up within a few minutes. Identifying labels, visible from the outside, may be sealed with core.

A NEW core analysis service, employing an improved method of wrapping, sealing and transporting of cores, makes complete laboratory work available to oil companies operating in foreign fields and remote domestic areas.

Through the use of special lightweight containers and air transportation, little time is lost in getting cores from such distant points as Venezuela to a central laboratory in the U. S. Within 24 hours from the time cores are received at the laboratory, the operator can have on his desk a telephoned, telegraphed or cabled report of the core analysis.

Because of the unique and efficient method employed in packaging and shipping the cores, the samples are preserved and kept intact to an extent heretofore impossible or uneconomical on a scale adaptable to conditions found on the typical remote drilling wells.

Cores Sealed in Plastic

Minutes after the core barrel is pulled from the well, a field sampler takes the individual core sections, upon their removal from the core barrel, and wraps them in aluminum foil. Each sample thus wrapped is placed in an individual plastic cylindrical container and a clear, synthetic plastic resin then is poured around and completely over the wrapped sample. This resin, poured at atmospheric temperature and pressure (Figure 1), sets up solidly within a few minutes. The individual samples thus are hermetically sealed, and without being subjected to external heat or pressure. The plastic material, when set up, has sufficient strength to preserve the original shape of the core sample and protect it against external shock. There is no invasion of foreign material into the sample, and because of the fact that an identifying label, easily seen from outside of the clear plastic core container, can be sealed in with the core, there is no chance that identity of the core can be lost or confused with that of another core.

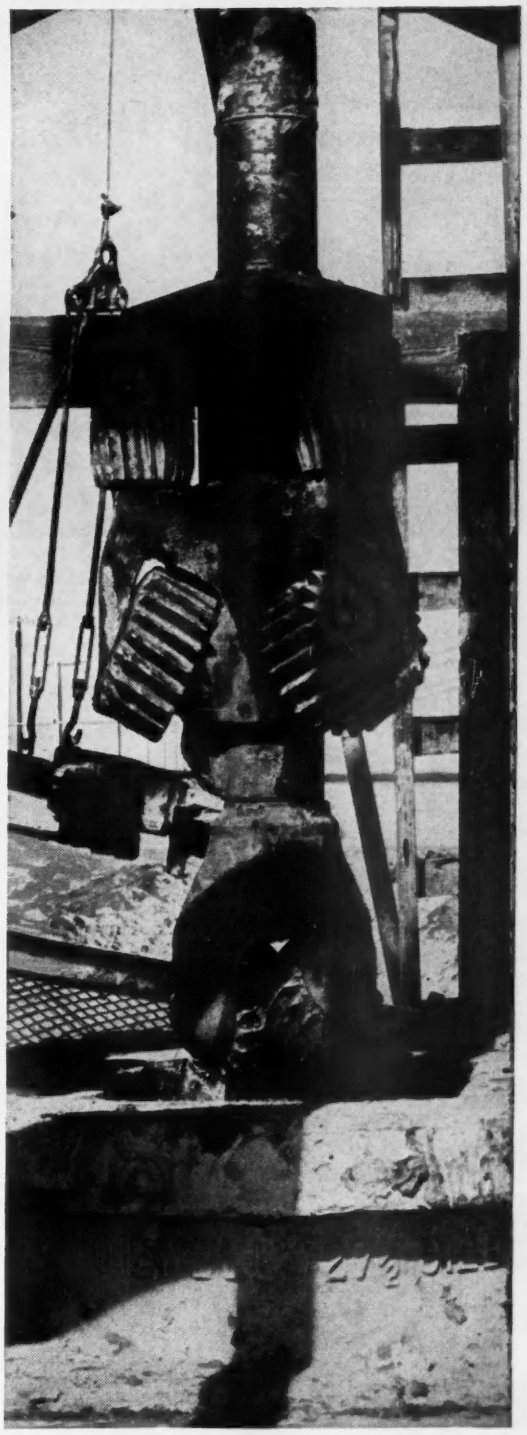
Following the setting of the plastic sealing material, the individual containers are placed inside larger and longer clear plastic tubes (Figure 2). The longer tubes then are placed inside a lightweight aluminum carrying case especially designed to withstand the rough treatment usually encountered in the transporting and handling of cargoes. The carrying case holds nine of the plastic tubes and is equipped with a pair of carrying handles. Normally, six core samples can be carried in a tube. A single carrying case, therefore, will hold approximately 54 samples.

Sealed and packaged ready for shipment, the samples are ready for delivery to the laboratory. In most instances, air transportation is not too far away from a drilling operation. It has been the experience of companies operating in Venezuela, for example, that there usually are at least one or two flights per day out of local airports, funneling cargoes into the main international airport near Caracas. Regular U. S. airliners then carry the core shipments, under bond, to the states, entering at either Houston or Los Angeles. If shipments enter at Houston they are trans-shipped to Los Angeles, in which area the laboratory referred to is located. A broker, experienced in the ramifications of international shipment of goods, usually is on hand at the point of entry, and upon notification by cable that sample shipments are en route, sees to it that no delay is experienced in clearing the core sample case through customs and speeded on to the laboratory.

Within 24 hours after the samples reach the laboratory, the latter operating on a round-the-clock basis, results of the analysis are telephoned, wired or cabled to the operator. Final reports usually are mailed to the operator upon completion of the coring of the particular well.

Advantages of the plastic sealing tech-

NICKEL ALLOY STEEL rock bits ready for shipment from the plant of H. C. Smith Oil Tool Co.



How to combine STAMINA and COMPACTNESS in a rock bit

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At the same time, each component part in a complete design must provide the strength, toughness and extreme hardness to withstand severe abrasive attacks as well as high shear and torsional stresses.

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The cutters are of nickel-chromium-molybdenum steel...case-hardened to provide a hard cutting edge resistant to abrasion.

The crossarms, which serve as bearing supports for the cutters, are nickel alloy steel forgings.

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THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK 5, N.Y.

FIGURE 2. The sealed, individual containers are placed inside slightly larger, longer clear plastic tubes. Nine of these tubes then are placed inside a specially designed aluminum carrying case.

FIGURE 3. The lightweight cases are equipped with convenient carrying handles for easy handling. Each case normally holds approximately 54 core samples, six samples in each of the nine tubes. Cases are built to withstand the rigorous treatment often encountered in foreign handling.

FIGURE 4. Sealed and packaged ready for shipment, sample cases are rushed to nearest airport for delivery to laboratory in the States. Within 48 hours from time of receipt at laboratory, test results are cabled, wired or telephoned to the operator.

nique become readily apparent when comparative laboratory findings are examined. In a number of test cases conducted, two identical core samples were taken from a particular well and shipped to laboratory for testing. In each case, one sample was wrapped in aluminum foil and sealed in a pint-sized screw-top jar and the other was wrapped in similar foil, but then was covered over with the plastic resin material and sealed in the plastic tube type container. Upon arrival at the laboratory, the core samples were run through identical test procedures. It was found that similar samples often showed a fluid content which varied over a range of from 5 to 20 percent, the losses having occurred in those samples which were not sealed completely with the plastic material at the time the cores were removed from the core barrel.

Evaporation and drainage of fluid from core samples often are not the only factors that must be considered. The physical characteristics of the rock, or minerals in the rock, may change to an extent that the rock, or minerals, may not be the same as when it was removed from the core barrel. On prolonged exposure, pyrite will oxidize and leave a deposit of free sulfur; feldspars may break down or decompose into kaolins. Such changes occurring in the mineral grains may cause porosity and permeability test results to vary widely.

Core Analysis Saves Doubtful Well

Another example of the benefits of the improved core-handling techniques can be seen in the actual case of a development well that was being drilled in a foreign field. It was admittedly a marginal location, and in the interval where production was expected, the electric log and core samples (the latter had not as yet been analyzed) indicated that the zone probably would not produce, or at least make a commercial well. The operator even decided not to set casing on it, and under normal circumstances the well probably would have been abandoned. The zone in question was a silty, shaley formation that normally would be discounted as a reservoir rock.

Despite these outwardly discouraging appearances, however, samples of the formation were removed, sealed in plastic containers and shipped for analysis. The results of these tests turned out to be very favorable, and the well ultimately was completed, flowing, for between 100 and 150 barrels per day. The successful completion of this well immediately caused the re-examination of logs of other wells in the vicinity, and it is believed that substantial reserves previously passed up may be developed in that horizon.

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Oil's Oasis in *Saudi Arabia*

Foreground residential section of Dhahran shows comfortable bungalows which Aramco provides for employes. The building in the center is the dining hall where bachelor employes take their meals. U-shaped building in the background is the administration building.

A meeting of the ninth grade at Dhahran, Saudi Arabia. The Arabian American Oil Company has now added junior high school classes for the children of its employes in Saudi Arabia who have completed their elementary schooling.

The E. C. Singelyn family enjoys a day at the beach at Ras Tanura, Singelyn is assistant comptroller of Aramco.

AS MODERN and progressive as any town in the U. S., the American communities at Dhahran, Ras Tanura and Abqaiq in the Saudi Arabian desert are examples of Yankee community life far from home. These towns close to the Persian Gulf, 8000 miles from New York's skyscrapers, were planned and developed by the Arabian American Oil Company for more than 2000 employes and their families.

All buildings are air-conditioned and constructed to fit climatic conditions. Homes are landscaped with tropical shrubbery. The recreation centers house game rooms, libraries, bowling alleys and snack bars. There are out-of-door swimming pools, dance patios, picnic grounds, well-lighted tennis courts, and baseball diamonds. At Ras Tanura Aramco has just completed a new movie theatre.

A little theatre group, Dramaramco, presents

ABOVE LEFT: Abqaiq Annie, camel mascot of the Abqaiq All-Stars Softball team in Saudi Arabia, kneels with the boys to pose for a group picture. "Annie" is credited with bringing good luck to the team that has just won the championship of Saudi Arabia. The teams are made up of Arabian American Oil Company employes from the towns of Dhahran, Ras Tanura and Abqaiq, 8000 miles from New York.

stage performances at the modern new building. Actors, directors and technicians are all company employes.

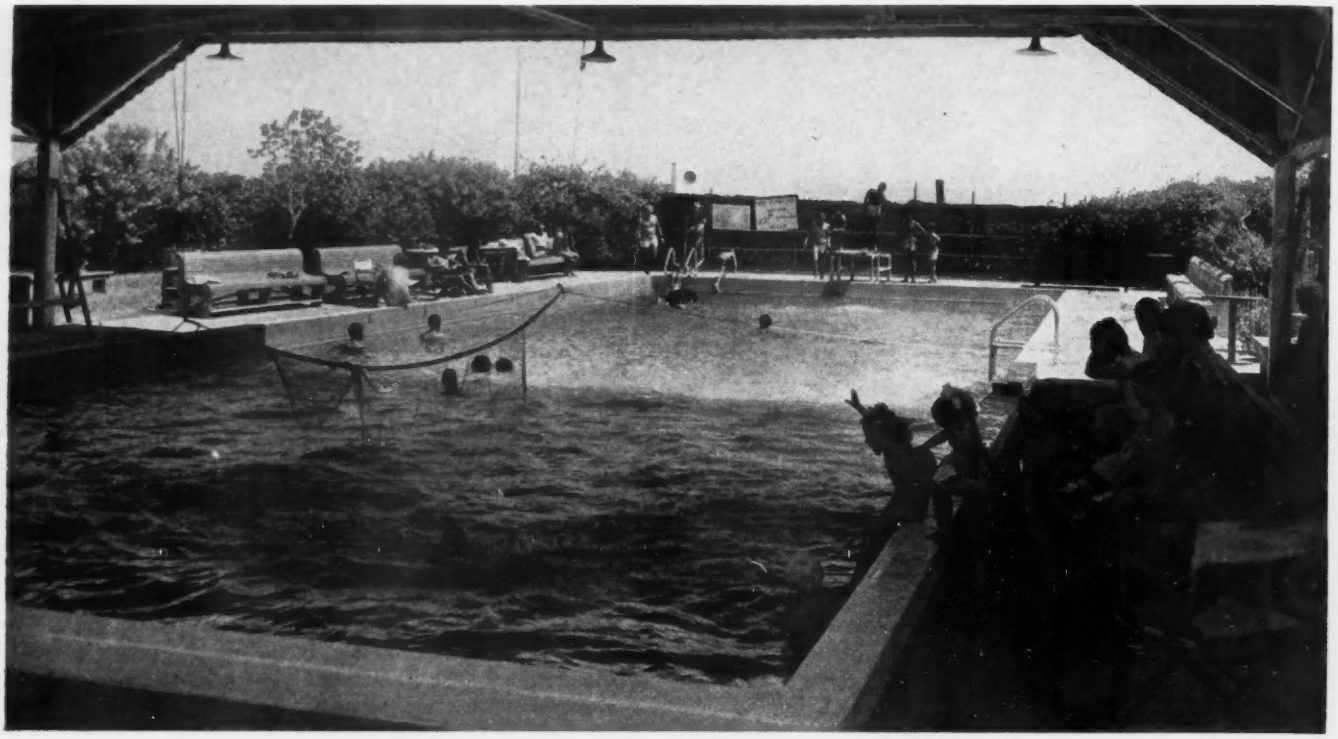
There are intramural softball games and tennis matches are to be played between Aramco teams and teams from other oil companies in the Middle East. Employes fish, swim and boat on the Persian Gulf.

An up-to-the-minute educational system provides more than 250 children of Aramco employes with well-equipped school buildings, teachers, playgrounds and books. A new junior high school was added recently.

★

ABOVE RIGHT: Employes at Ras Tanura see their movies in a threatre as modern and comfortable as any to be found back home in the U. S. Marking the entrance to the new Ras Tanura Theatre, just completed, are these jutting, plastered pylons, Egyptain style. Built on desert sands, the threatre stands only a few hundred feet from the water of the Persian Gulf. An open air bowl equipped with projection machines for outdoor movies at night is built into the west facade. Ras Tanura averages 265 clear evenings during the year.

Employes dancing on the patio at Dhahran.



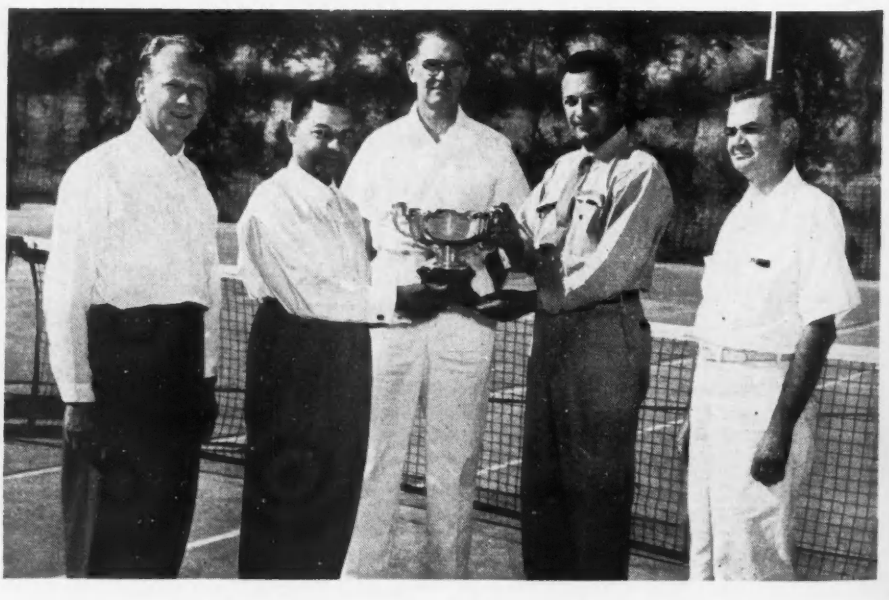
Employes and their families take frequent plunges into the fresh water pool which is the favorite relaxation spot in town.

★

Waiting for school to start, youngsters of the ninth grade class gather on the steps. These students have completed their elementary schooling in one of Aramco's air-conditioned desert schools and now attend junior high school.

★

This silver trophy is the "Davis Cup" for tennis teams in the Persian Gulf area. Donated by Sba Habachy-Pasha, Egyptian attorney (second from left), the trophy is being accepted here by officials of Arabian American Oil Company at Dhahran, Saudi Arabia. Tennis teams which will compete annually for the trophy are made up of employes from Bahrein Petroleum Company, Bahrein; Kuwait Oil Company, Kuwait; Anglo Iranian Oil Company, Iran; Iraq Petroleum Company, Iraq; American Independent Oil Company, Kuwait Neutral Zone, owned jointly by Saudi Arabia and Kuwait, an Arabian American Oil Company. Photo shows (left to right), F. W. Ohliger, vice president, Saba Habachy-Pasha, F. A. Davies, executive vice president, George W. Knight, manager of community services department, and T. V. Stapleton, general manager.



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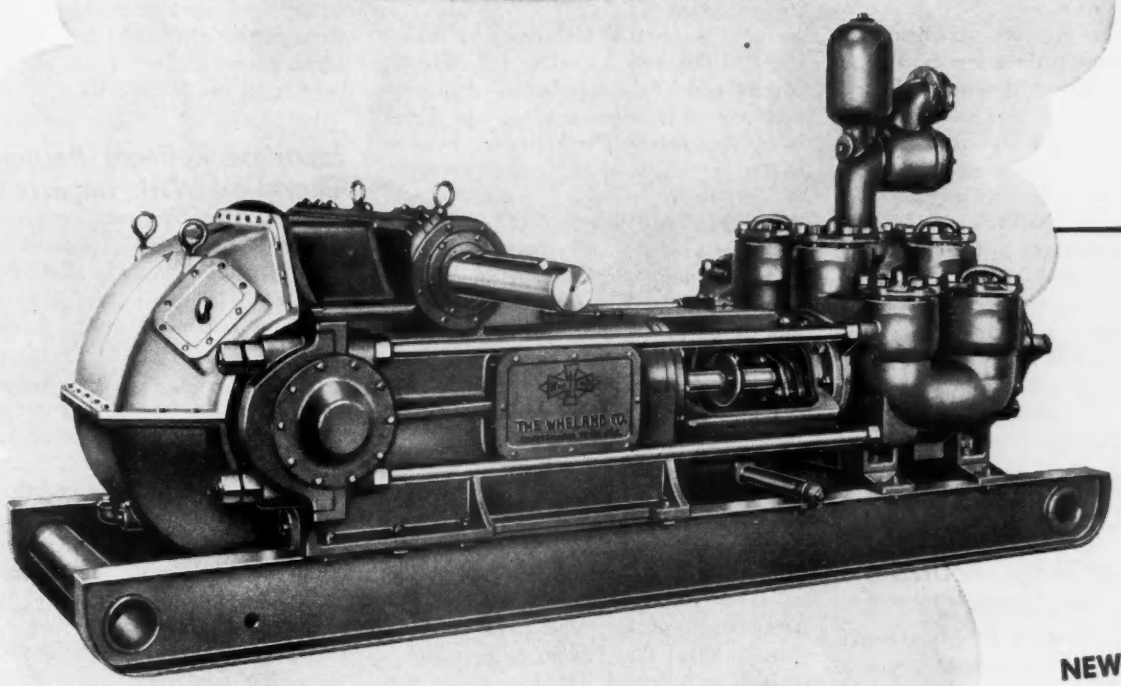

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Aramco on Soft Currency Basis To Reduce Dollar Cost of Oil

Arabian American Oil Company is converting its operations in Saudi Arabia to a "soft currency" basis wherever possible. The new arrangement is the result of the world dollar shortage and is intended to reduce the dollar cost of Middle East crude.

W. F. Moore, Aramco president, explained the move in these words: "Companies which market Aramco oil have advised us that from now on they must be prepared to accept at least part payment for Aramco's oil in so-called 'soft currencies'—currencies which are not exchangeable for dollars. It follows, therefore, that Aramco in turn will have to maximize the use of soft currencies in the payment of its operating and investment expenditures, including payments to the Saudi Arab government."

A result of the program will be that shipping will be arranged largely in ships of companies that will accept soft currencies for freight. Foodstuffs will be purchased almost entirely in countries where soft currency can be used, and, Moore says, "we must expect the familiar standard American brands to disappear gradually from our commissary shelves."

The company will intensify its training program so that Saudi Arabs will be able to perform more jobs which hitherto required American skill. Hence, Moore adds, "the number of American employes is expected gradually to shrink over the years. Furthermore, because of the necessity of using soft currency for company payrolls, many of the Americans will be replaced over the next few years by skilled employes from soft currency countries." However, he emphasized, "a substantial American organization providing basic American industrial 'know-how' and an efficient Saudi Arab training organization will be continued as long as Aramco remains in business in Saudi Arabia."

Community life in Dhahran, Abqaiq and Ras Tanura will be affected in several ways. Employes in the future will pay for some services and benefits which are now free. However, in lieu of these former benefits they will receive an allowance which will approximately offset the charges to be made.

It is understood Aramco is negotiating with Saudi Arabia for part payment of its 22-cents a barrel royalty in soft currencies. The company's royalty payments plus purchases made in the U. S. amounted to more than $100 million in 1949, or an average of about 60 cents a barrel.

Moore said Aramco oil already has been displaced by British oil in parts of the Far East, United Kingdom, Argentina, Sweden and Egypt, and warned "It seems likely that Aramco oil will be excluded from markets in other large areas of the world as well unless corrective measures are taken."

Paraguayan Chaco Activities Abandoned by Union Oil

Union Oil Company has abandoned as a dry hole its fifth exploratory well in the Paraguayan Chaco region and the company has announced that operations there have been discontinued. The company has been actively exploring this region, a little more than half the size of the state of California, for approximately five years. With the information gathered during this period, the company has concluded that it is unlikely that fields of major size sufficient to warrant the capital investment necessary to develop them would be discovered.

Exploratory Drilling Planned In North Holland This Year

The Netherlands' only oil production is from the Schoonebeek field on the border between Holland and Germany, but a search for additional fields will be made in North Holland this year.

The N. V. Nederlandse Aardolie Maatschappij, jointly owned by the Shell Group and Standard Oil Company (N. J.), will conduct an exploratory drilling campaign in the Zaan Region and at Warmenhuizen. The latter area will receive first attention and drilling will take place in the first half of the year. It is reported that equipment capable of drilling to 10,000 feet will be used.

Sizeable Expansion Planned For Chile's Oil Industry

Corporación de Fomento de la Produción (CORFO), the agency responsible for developing Chile's oil resources, plans to spend $4.6 million and 170 million pesos (62 pesos to a U. S. dollar), or an equivalent of 455.2 million pesos, in finding and producing more oil, and providing facilities for its new industry in 1950.

New drilling will be carried out in the existing oil fields and gravimetric and seismic surveys will be made in new areas of Tierra de Fuego, on the southern bank of the Straits of Magellan. New roads will be built to the oil fields, and a crude stabilization plant will be constructed. This plant is needed to treat the Cerro Manantiales field's high paraffin content crude for pipe line movement.

After making its first crude export in February, Chile will ship about 750,000 barrels to Uruguay this year, which will take care of about 13 percent of that country's requirements. Chile is in a favorable position for that market since tanker-time to Montevideo is only 3½ days compared with 13 days from Venezuela, about 15 days from Peru and 30 days from the Middle East.

Japanese Refinery Resumes Operation With Imported Oil

Japan is refining imported crude for the first time since the close of the war. Until recently, Japan's postwar petroleum needs have been largely met with imported refined products purchased with U. S. funds. The decision to reopen some of the country's plants for resumption of domestic refining is expected to result in savings of $25,000 a day.

The Shimizu refinery southwest of Yokohama with a daily capacity of 4000 barrels a day is now in operation. Two hundred miles west, the reconstructed Wakayama plant is about ready to go on stream with a daily throughput capacity of 6000 barrels. Both plants are owned by Toa Nenryo Kogyo, the company in which Standard-Vacuum Oil Company recently bought 51 percent interest. Standard-Vacuum is jointly owned by Standard Oil Company (N. J.) and Socony-Vacuum Oil Company, Inc.

Coryton, England, Refinery Planned by Vacuum Company

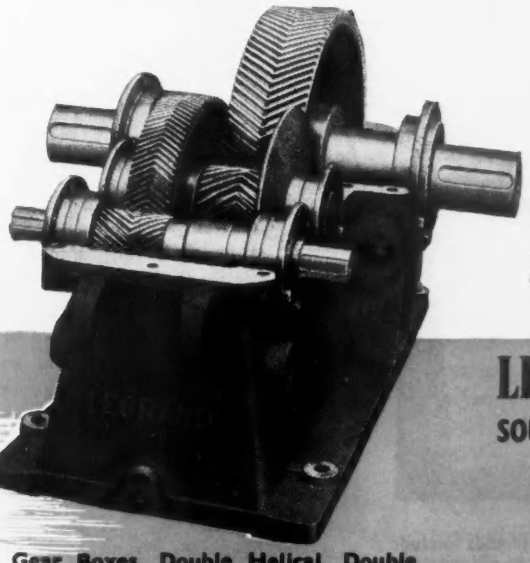
Plans for an oil refinery at Coryton, England, were announced by Vacuum Oil Company, Ltd., subsidiary of Socony-Vacuum Oil Company, Inc. The $30 million plant will specialize in making high grade lubricating oils, and will have an input capacity of 20,000 barrels a day.

Middle East crude will be processed and the products are intended to replace those that are being imported from dollar sources. Refining operations are scheduled to start within 2½ years.

Czechoslovakia Has Discovery

The discovery of oil has been reported near Malacky, Slovakia. Russian authorities will take over the production, and it is said that they consider the occurrences to be an extension of the important Austrian oil fields near Zisterdorf.

LE GRAND Pumping units



Gear Boxes, Double Helical, Double Reduction, built to A.P.I. Specification.

LE GRAND'S units range from 3,000 lbs., Polished Rod Load with intermediate sizes up to 31,000 P.R.L.

LE GRAND'S manufacture in England under licence the products of OIL CENTER TOOL CO., Houston, Texas, U.S.A.

LE GRAND SUTCLIFF & GELL LTD

SOUTHALL, MIDDLESEX, ENG. ROCHESTER, KENT, ENG.

Telephone: Southall 2211 Telegrams: Legrand, Southall.
Codes: A.B.C. 6th Edition.

OILFIELD EQUIPMENT MANUFACTURERS & FOUNDERS

Saudi Arabia Crude Output Drops 17 Percent in Month

Crude production in Saudi Arabia averaged 411,536 barrels a day during March, according to Arabian American Oil Company. That was 84,903 barrels a day or 17.1 percent less than output in February, and 78,284 barrels a day or 16 percent less than in March, 1949.

Aramco also reported that it ran 72,075 barrels of crude a day into its refinery at Ras Tanura, while 117,799 barrels a day were processed in February. That shows a drop of 38.8 percent in the month's refinery operations. A year ago refinery runs averaged 55,207 barrels a day or 43.4 percent greater.

For the first three months of 1950, crude production in Saudi Arabia averaged 451,176 barrels daily, which was 63,587 barrels or 12.4 percent under last year's rate.

In the same period, input at Ras Tanura amounted to 94,878 barrels a day, and that failed by 34,268 barrels a day or 26.5 percent of matching refinery runs during the first three months of 1949.

Oil Consumption Continues Rise in Marshall Plan Nations

Oil consumption in the 16 Marshall Plan nations of Europe has expanded to 856,000 barrels a day for fiscal 1949, the Economic Cooperation Administration reports. Estimated consumption for fiscal 1950 is about 942,000 barrels daily, and consumption is expected to grow to about 1,014,000 barrels by 1951, ECA estimates.

Crude oil production in these same countries was only 34,000 barrels a day for 1948, but will increase to about 48,000 barrels daily for 1950. ECA estimates that output may reach 60,000 barrels a day by 1953 when the Marshall Plan ends.

ECA disclosed that since the start of the aid program, procurement authorizations have been issued totalling $5.5 million for drilling equipment and refinery maintenance in Western Europe and French overseas territory. There has been no ECA financing of drilling equipment for the United Kingdom or for the overseas operations of the British oil companies.

Procurement authorizations through February, 1950, for crude oil and petroleum products for the Marshall Plan countries, including French overseas territories, amounted to $808 million. Of this, $252 million came from the United States, $256 million from other Western Hemisphere countries, and $300 million from the Middle East and other sources. More than 80 companies have participated in the shipments.

Dunkirk Refinery Producing First Products Since War

First petroleum products to be refined at Dunkirk, France, since 1940 are being produced at Societe Generale des Huiles de Pétrole's partially completed refinery. Tankers are laying down cargoes of Middle East crude at this Northern France port, and a topping unit, capable of processing 300,000 tons a year (about 6,000 barrels a day), has been put into operation.

The new refinery is being built on the site of Raffinerie de Pétrole de Nord's prewar plant, which was bombed in 1940 and dismantled in 1943 by the Germans. Construction was started in the middle of 1947 and is scheduled to be completed late in 1951. When complete, full capacity will be 1,400,000 tons per year, and crude from Iran and Kuwait will be processed.

Initiation Rituals for new members in the Dallas-Fort Worth Chaper of Nomads include costumes and placards for the neophytes to assist them in becoming acquainted. Pictured is the group which joined the chapter at a recent meeting.

Venezuelan Spokesman Takes Optimistic View of Future

An optimistic view of Venezuela's ability to compete with other oil-producing nations was taken by Dr. Manuel R. Egana, secretary of the Venezuelan Department of Development, in a talk before government and industry representatives at Caracas.

Dr. Egana listed Venezuela's major problems and outlined their possible solution as follows:

- Increasing competition from Middle East Oil.

  Dr. Egana believes Venezuelan oil will be able to compete with Middle East oil in European markets until completion of the trans-Arabian pipe line. This is because the cost of transporting Middle East oil to Europe is much greater than that of moving Venezuelan oil to these markets.
- Increased production in Western Canada.

  He said his country's oil industry probably has little to fear from Canadian oil for about ten years. This is because the growing production of the western provinces of Canada will probably be consumed in that area and in that part of the U. S. near the Great Lakes. Eastern Canada will continue to draw its oil from the U. S., Venezuela, and the Middle East, he believes.
- British restrictions on oil imports and proposed restrictions on oil imports into the U. S.

  He believes an acceptable agreement will be reached by British and American governments on the problem of the British cut in imports of American company oil. He also believes that efforts to limit U. S. imports will not succeed because "they are in conflict, not only with the good neighbor policy which exists between the countries of this continent, but with the very interests of the U. S. A. at present and in the future."

Mexico's Salamanca Refinery Goes Into Operation Soon

Mexico's new $12 million Salamanca refinery is in the final stages of construction, according to PEMEX, Mexican government oil company. Designed for a capacity of 30,000 barrels of products daily, the plant will be supplied with Poza Rica field crude through the recently completed 280-mile 12-inch pipe line.

Senator Antonio J. Bermudez, director general of PEMEX, announced that the plant will be on stream in May or June. The refinery is near the town of Salamanca, State of Guanajuato, 180 miles northwest of Mexico City.

NEW AND IMPROVED EQUIPMENT

SUPPLEMENTING COMPOSITE CATALOG

157—Rock Bit

This item supplements H. C. Smith Oil Tool Company data as shown on pages 4505-4524 of Composite Catalog, 17th Edition.

A new two-cone rock bit provides extremely effective circulation. Twin jets are positioned to agitate and assure fast removal of cuttings and at the same time prevent balling-up of cutter teeth. The bit has a single-piece, heat-treated alloy steel body and triple bearing construction of the cones. Ball thrust and roller annular bearings provide long wear and maintenance of accurate gauge and straight hole. Teeth are hard-surfaced with tungsten carbide.

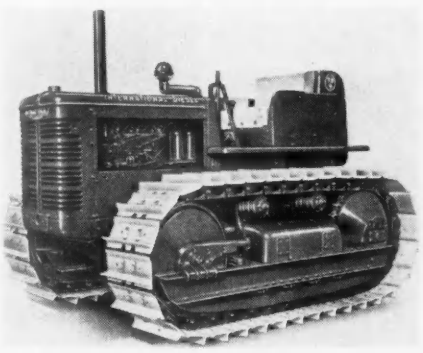
In field tests, the bit has given good footage, at fast drilling rates, in a variety of soft to medium-hard formations.

For additional information, write H. C. Smith Oil Tool Company, P. O. Box 431, Compton, Calif.

158—Crawler Tractor

This item supplements International Harvester Company data as shown on pages 2537-2540 of Composite Catalog, 17th Edition.

Changes in the "9" series four-cylinder engine have resulted in high power-performance ratings for the International TD-9 diesel crawler tractor, the manufacturer claims.



Drawbar horsepower of the new model is 40.5, compared to 38.88 in the previous model. Horsepower at the flywheel is 51.5, an increase of two hp. and belt horsepower, formerly 45.91, has been raised to 48.5. Maximum drawbar pull in first gear with the engine operating at maximum torque is 11,400 pounds.

The redesigned combustion system has new pistons, improved precombustion chamber, simplified injection nozzles, and higher compression ratio—15.7:1 as compared to 14.4:1.

For additional information, write Industrial Power division, International Harvester Company, 180 North Michigan Avenue, Chicago 1.

159—Blind Valve

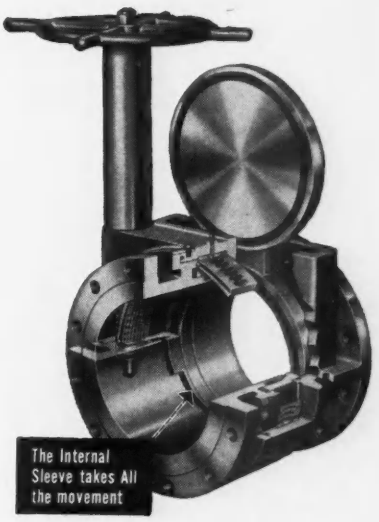
This item supplements Hamer Oil Tool Company data as shown on pages 2097-2172 of Composite Catalog, 17th Edition.

An internal sliding sleeve seals against and releases the spectacle plate of the new "Rigid" line blind valve without movement or expansion of the pipe line. The sleeve is moved against or away from the plate by means of a ball bearing mounted ring gear actuated by turning the hand wheel. Operation is not affected by misalignment or expansion and contraction of the pipe line. The spectacle plate can be reversed in less than a minute.

Face-to-face dimensions are the same as those of standard gate valves in all series. All parts are steel except the ring gear, which is high tensile bronze. Working parts are enclosed, packed in lubricant, and sealed to prevent contamination of line fluid or its entering the mechanism. The spectacle plate slot is open only at the top so that loss of product and fire hazard due to spillage are avoided while the plate is being reversed.

The valves are available in ASA 150- and 300-pound classes in sizes from 6 to 12 inches.

For additional information, write for Bulletin 350, Hamer Oil Tool Company, 2919 Gardenia Avenue, Long Beach 6, Calif.



Save Time—Write Direct

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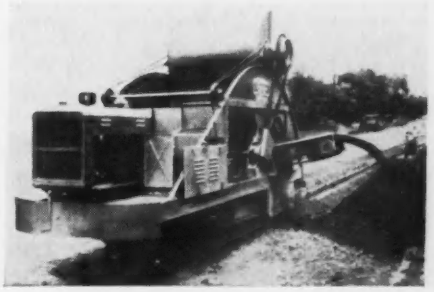
160—Trenching Machine

This item supplements The Parsons Company data as shown on page 4082 of Composite Catalog, 17th Edition.

The improved 250 Trenchliner has a range of 30 digging feeds that permit excavating from 1½ to 3½ cubic yards per minute, depending on depth, width and soil conditions. It will dig 16 to 42 inches wide and up to 12½ feet deep. The machine is equipped with three forward traction speeds, one reverse, and has three bucket line and conveyor belt speeds.

Arch-type frame is used for maximum strength, low overhead clearance and digging balance. Shiftable boom permits off-center digging within 1¼ inches of outside edge of either crawler. The reversible conveyor shifts by power to either extreme side of the machine in less than one minute for controlled discharge of spoil or truck loading.

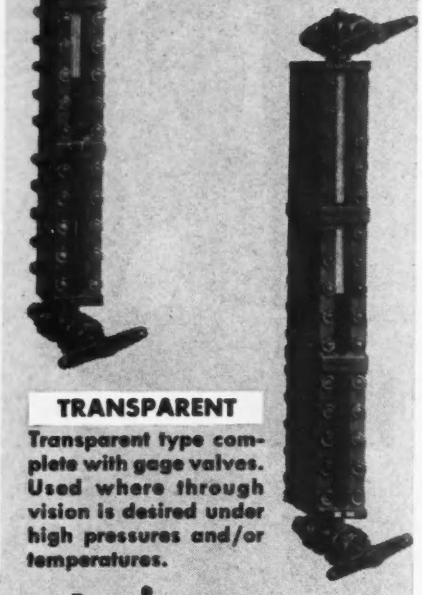
For additional information, write The Parsons Company, Newton, Iowa.



PENBERTHY
Liquid Level GAGES

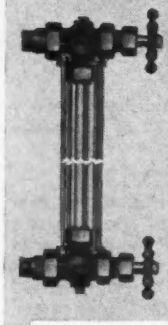
REFLEX

Reflex type complete with gage valves. Liquid shows black—empty space shows white. Liquid level is always unmistakable.



TRANSPARENT

Transparent type complete with gage valves. Used where through vision is desired under high pressures and/or temperatures.

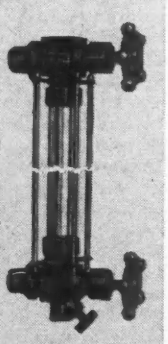


DROP FORGED STEEL

Tubular glass type, Chrome-Moly temperature resisting steel body, stainless steel trim, regrinding removable seats.

ALL IRON

Tubular glass type, extra heavy body of special high strength alloy iron, shanks alloy steel, trim stainless steel, valves self-cleaning.



There is a Penberthy Gage of superior quality for every liquid level gage requirement. Gages are fabricated to customer's specifications from special alloys to meet unusual corrosive and temperature conditions. All Penberthy Gages conform with API-ASME requirements.

3277-8

PENBERTHY INJECTOR CO.
Detroit 2, Mich.
Canadian Plant — Windsor, Ontario

NEW EQUIPMENT

SUPPLEMENTING COMPOSITE CATALOG

161—Intensifier

This item supplements The Cooper-Bessemer Corporation data as shown on page 1280 of Composite Catalog, 17th Edition.

A simple setup for static pressure testing of boilers, piping systems, compressor cylinders and similar pressure vessels is provided by a new air operated hydraulic pressure generating device. Developing up to 23,000 pounds per square inch, the intensifier is suitable also for many types of laboratory destruction tests where extremely high pressures are involved.

The intensifier weighs 80 pounds and is mounted on a two-wheel rubber tired under-carriage. Operation requires only connecting the intensifier to an ordinary compressed air line.

In operation, the instrument draws oil from its built-in supply reservoir. Variable static hydraulic pressures are

preset by a turn of the regulator valve that is equipped with a dial-type air pressure gauge. Any static pressure up to 23,000 pounds per square inch can be built up by using line pressures up to 90 psi.

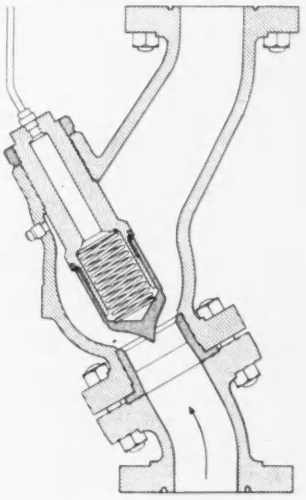
For additional information, write The Cooper-Bessemer Corporation, 200 Thomas Avenue, Mt. Vernon, Ohio.

162—Check Valve

This item supplements Grove Regulator Company data as shown on pages 1909-1932 of Composite Catalog, 17th Edition.

Fullstream check valves are available as wide open check valve for line check service and the Fullstream compressor check valve. Either type may be had in the "S" series, in which there is only a 30-degree change in flow direction, or the "SL" series 90-degree angle valves.

The valves have extremely low pressure drop—in the two-inch size equal to less than seven feet of pipe. The valve control point is placed far enough downstream to obtain a two-pound pressure drop in the line. This results in a two-pound static pressure differential within the valve, between the valve body and piston space, thereby overcoming the weight of the piston and the force of the



spring, allowing the valve to open wide and to stay open without frictional pressure drop. An "O" ring seal seals the piston when the valve is open.

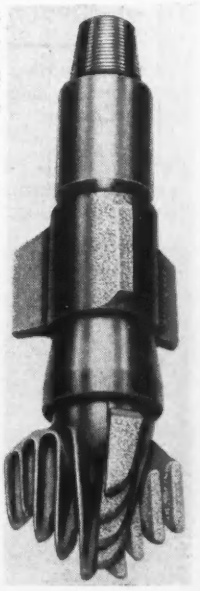
To adjust the orifice to control the speed of closure, the Allen screw is turned from the outside. The controlled flow closes the valve slowly with a cushioning effect.

Moving parts are made of corrosion resistant materials.

For additional information, write Grove Regulator Company, 3608 Navigation Boulevard, Houston.

163—Rock Cutter Bits

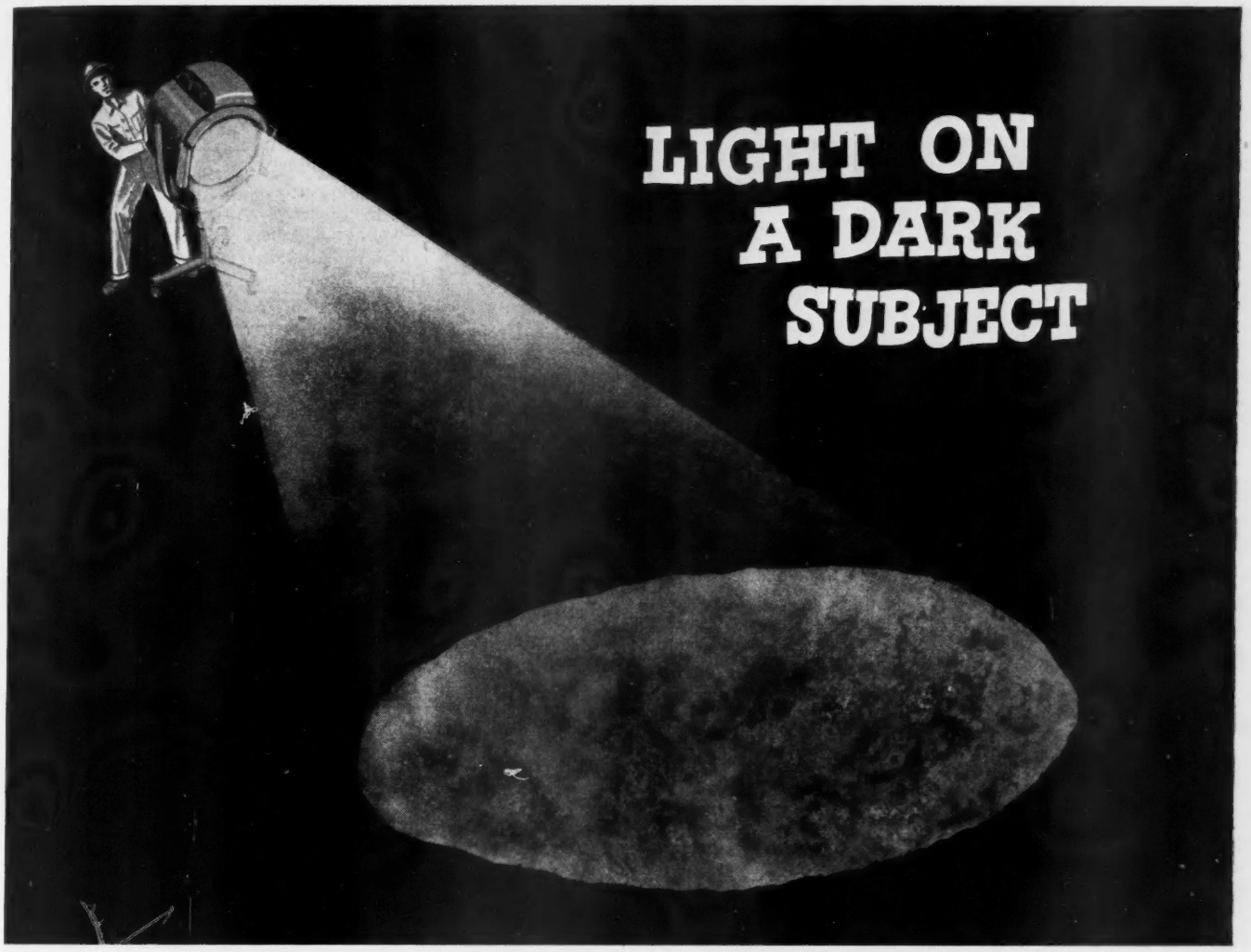
This item supplements Herb J. Hawthorne, Inc., data as shown on pages 2186-2189 of Composite Catalog, 17th Edition.



"Blue Demon" rock cutter bits are being made in additional sizes for slim hole production drilling, water-well drilling and mining exploration. Sizes range from 1⅞ to eight inches.

The bits have replaceable blades of "finger" design. The blades are liberally hardfaced.

For additional information, write Herb J. Hawthorne, Inc., P. O. Box 7299, Houston 8.



Although it is in regular use in many fields, BAROID EMULSION MUD is a recent development, and many operators are still somewhat in the dark about it. So here, briefly, are its high lights.

BAROID EMULSION MUD is essentially a high-*p*H-lime mud with crude or Diesel oil emulsified therein by CARBONOX. Weight and gel materials, such as Baroid, Aquagel and Impermex, may be used as with a normal clay-water mud.

BAROID EMULSION MUD

1. ***Resists Contamination*** by gypsum, anhydrite, salt or cement.
2. ***Resists High Temperatures*** met in deep drilling.
3. ***Has Low Water Loss***—as low as ½ cc. API, if desired.
4. ***Is an Excellent Lubricant,*** reducing drill pipe torque and increasing rock bit bearing life.
5. ***Is Stable.***
6. ***Is Easily Maintained.***
7. ***Is Adaptable*** to a wide range of drilling conditions.
8. ***Is Easily Mixed.***
9. ***Is Not a Fire Hazard.***
10. ***Washes Off Easily***

...and you can easily convert your present clay-water mud to Baroid emulsion mud

Your Baroid Service Man will be glad to tell you all about...

Baroid
BAROID SALES DIVISION
NATIONAL LEAD COMPANY
LOS ANGELES 12 · TULSA 3 · HOUSTON 2

EMULSION MUD

50th Acme Anniversary

It just *has to be* a mighty good product . . . whose maker has stuck to it so long. As a world-market leader, Acme still specializes in:

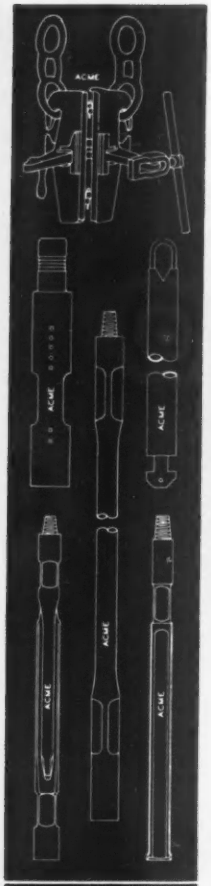
DRILLING *and* FISHING

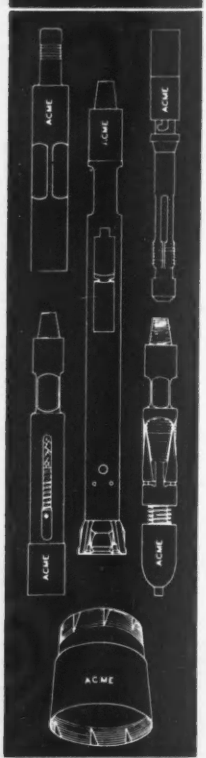
TRUSTWORTHY Cable Tools

See Acme's latest condensed Catalog and tool-use Manual in Composite Catalog (up front—in Vol. 1). Or mail penny postal TODAY for your copy. Cover-to-cover full of valuable information for Cable Drillers.

ACME DRILLING & FISHING TOOLS

Since 1900—this familiar symbol has assured more hole-footage per tool dollar.

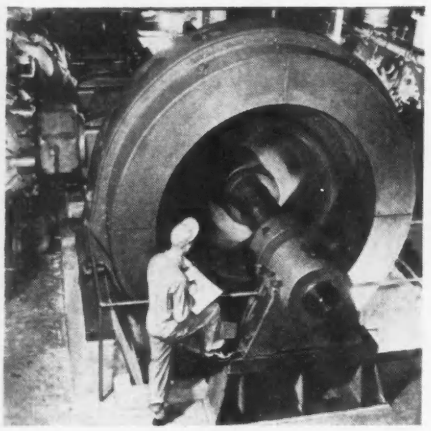




ACME FISHING TOOL CO.
PARKERSBURG W. VA.
Export Office:
19 Rector St., New York 6, N.Y.

164—Synchronous Motor

This item supplements General Electric Company data as shown on pages 1809-1820 of Composite Catalog, 17th Edition.

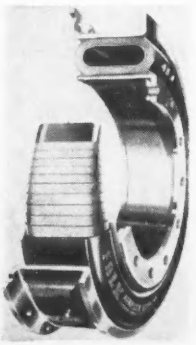


The largest synchronous motor in horsepower rating ever to be applied to drive a reciprocating compressor was installed recently in an Oregon plant. Driving a Clark six-cylinder compressor, the motor is rated at 4500 horsepower at 300 revolutions per minute, 11,000 volts. The compressor will handle up to 2,160,000 cubic feet per hour of manufactured gas at 40 pounds per square inch.

For additional information write General Electric Company, Apparatus Division, Schenectady 5, N. Y.

165—Coupling

This item supplements The Falk Corporation data as shown on pages 1632-1633 of Composite Catalog, 17th Edition.



Torque capacity of the Airflex coupling has been increased 20 percent above previously published values, because of improved rubber composition and bonding. Hubs and adaptor plates have been redesigned to facilitate disconnection and removal of the entire gland assembly.

Redesigned components are interchangeable with the equivalent components of all Airflex couplings, and standard parts may be combined to allow six different mounting arrangements, including flange mounting on a flywheel. Stiffness factors may be controlled and are available for torsional analysis.

The coupling is primarily for engine drives and for applications involving severe torque fluctuations.

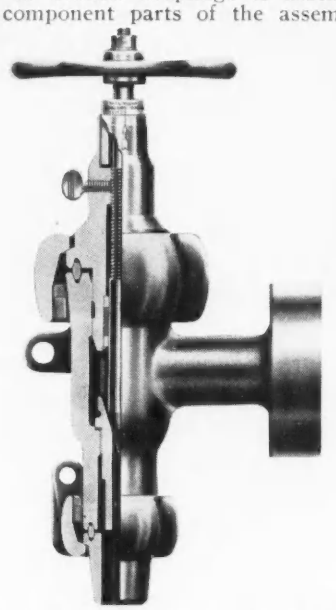
For additional information, write for Bulletins 8100 and 8105, The Falk Corporation, 3027 West Canal Street, Milwaukee 8, Wis.

166—Adjustable Choke

This item supplements Thornhill-Craver Company, Unibolt division, data as shown on pages 4753-4780 of Composite Catalog, 17th Edition.

Stem packing of a new adjustable choke, or wing valve, is arranged to eliminate the need for further tightening after the valve is assembled at the factory. Adequate sealing compression is applied to the packing to assure a pressure-tight seal yet permit the stem to turn freely in the packing.

The new valve has all mechanical features of the earlier Unibolt model, such as Unibolt couplings to assemble the component parts of the assembly,



complete interchangeability of all parts, self-centering stem, and adequate flow area to provide non-restricted flow when used as a wing valve in a positive choke manifold.

For additional information, write Thornhill-Craver Company, Unibolt division, 1111 Lockwood Drive, Houston.

Save Time—Write Direct

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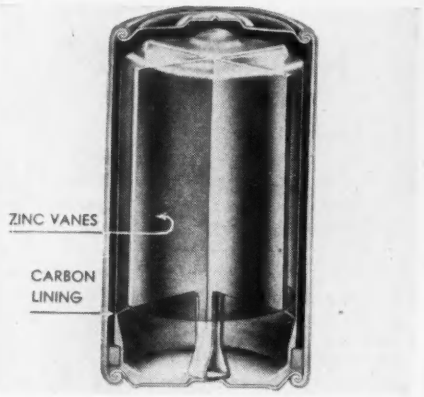
NEW EQUIPMENT
SUPPLEMENTING COMPOSITE CATALOG

167—Battery

This item supplements Union Carbide and Carbon Corporation data as shown on pages 2190-2191 of Composite Catalog, 17th Edition.



Container of the new "Eveready" No. 1050 industrial flashlight battery is made of carbon, with a zinc power vane as the center element. Carbon is inert to electrolytic action and hence will never perforate. The new cell has no metal can to leak or corrode.

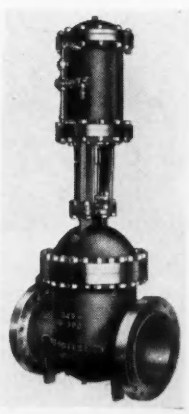
The battery is interchangeable with all D-size batteries.

For additional information, write National Carbon division, Union Carbide and Carbon Corporation, 30 East 42nd Street, New York 17.

168—Pipe Line Valve

This item supplements Kerotest Manufacturing Company data as shown on pages 2613-2632 of Composite Catalog, 17th Edition.

A new cylinder-operated pipe line valve has a reciprocating piston and cylinder mechanism.



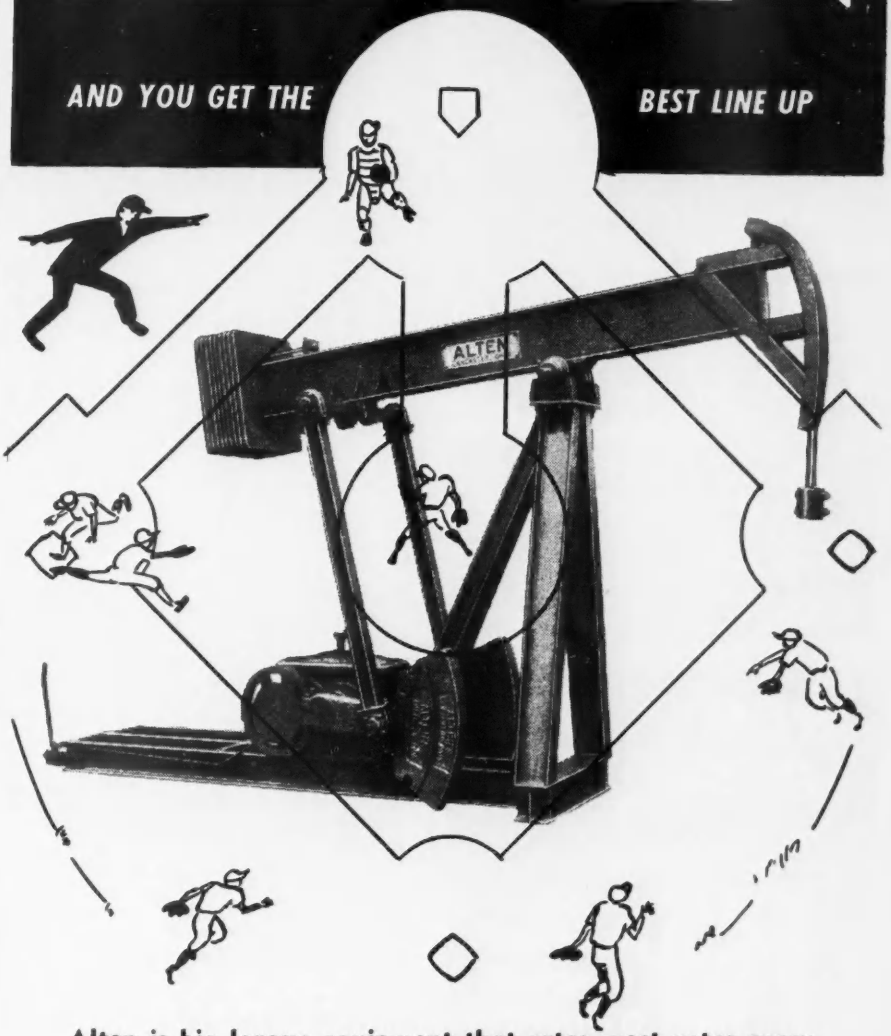
Operation is controlled by a four-way valve mounted on the piping leading to the cylinder. This valve admits pressure below the piston to open the large valve, and by a quarter turn, reverses the fluid to the area above the piston for closing the large valve, Air, gas, oil or water may be used to operate the mechanism.

To avoid accidental closing of the main valve caused by fluctuations in line pressure, the upper cylinder head has a stem-holding safety device which holds the valve in the open position until pressure is applied above the piston.

The cylinder-operating mechanism can be adapted for use on any type of Kerotest gate valve.

For additional information write Kerotest Manufacturing Company, 2525 Liberty Avenue, Pittsburgh 22.

LINE UP WITH
ALTEN
AND YOU GET THE BEST LINE UP



Alten is big league equipment that rates most votes every year as most valuable. 60 years of field service has proved Alten to have matchless stamina, endurance and dependability. Be sure of all star, stellar performance by insisting on Alten every time you buy equipment.

FIELD EQUIPMENT PUMPING EQUIPMENT SURFACE EQUIPMENT

ASK FOR COMPLETE ALTEN LINE AT YOUR LOCAL SUPPLY STORE

ALTENS FOUNDRY & MACHINE WORKS, INC.
LANCASTER, OHIO, U. S. A.

ALTEN

If you use pipe, you need – – –

RECTORSEAL #1

• INSOLUBLE IN OIL AND WATER

Rectorseal #1 is the perfect sealant for use on: (1) Drilling Rigs (2) Well Completions (3) Production Lines (4) In Refineries (5) Distribution Systems. Everywhere in the Oil Industry for the past 13 years Rectorseal #1 has proved its superiority as a perfect sealant in maintaining "leak-free," "trouble-free," "cost-free" connections. It's designed especially for the Oil Industry.

Ask your supply store or write—

RECTORSEAL, Dept. G, 2215 Commerce St., Houston, Texas.

RECTORSEAL

Manufactured by

RECTOR WELL EQUIPMENT CO., INC.

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MAKING THE OIL INDUSTRY SAFER

HEAVY DUTY-RUGGED....

THE INDUSTRY'S LEADING CENTRIFUGE

*3480

You can maintain your required speed for the full period of the test with much less effort. Curtin centrifuges, proven world-wide, are heavy duty, rigidly constructed, and extremely simple in design. Illustrated bulletin, giving full details, available upon request.

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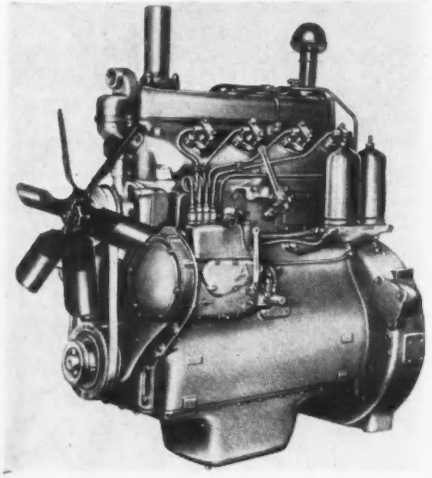
HOUSTON .... NEW ORLEANS

NEW EQUIPMENT

SUPPLEMENTING COMPOSITE CATALOG

169—Automotive Diesel

This item supplements International Harvester Company data as shown on pages 2537-2540 of Composite Catalog, 17th Edition.



Increased horsepower diesel power units and automotive engines of the four-cylinder International "9" series are now available in UD-9A models. Similar design changes have been made in both the automotive engine for motor graders and other self-propelled machines and the UD-9A power unit for stationary installations.

Changes include redesigned pre-combustion chamber and piston; the "A" series fuel injection pump; simplified injection nozzles; counterbalanced crankshaft and new connecting rods. Compression ratio is now 15.7 to 1 compared to the former 14.4 to 1.

As a power unit equipped with air cleaner, radiator, fan and clutch, the UD-9A delivers 62.5 horsepower at 1600 revolutions per minute under intermittent load. This compares with 53 horsepower at 1500 for the previous model. Weight is 2060 pounds; dimensions are 67¾ inches long, 28-1/16 wide, and 52 inches high.

The automotive engine operates at governed 1800 rpm, delivering 70 horsepower at that speed. It is 41½ inches long, 24 inches wide and 42½ inches high, without air cleaner. Weight is 1500 pounds.

For additional information, write International Harvester Company, Consumer Relations department, 180 North Michigan Avenue, Chicago 1.

170—Drill Pipe Protector

This item supplements U. S. Rubber Company data as shown on pages 4823-4831 of Composite Catalog, 17th Edition.

The new U. S. Rubber All-Purpose drill protector is made of standard neoprene compound which can be used with 96 percent of all kinds of drilling muds. Only wells using extremely hot oil base mud require a different rubber.

The smooth, streamlines end design minimizes the swirling turbulent action of the mud, which commonly causes abrasive "ringing" of the pipe at these points. It also controls stress concentration at the ends. The inside of the protector has an anti-slip finish. Four wiper rings molded in the ends provide protection against mud seepage and slipping on the drill pipe.

For additional information, write U. S. Rubber Company, 1230 Avenue of the Americas, New York 20.

171—Pumping Unit

This item supplements Bethlehem Supply Company data as shown on pages 677-704 of Composite Catalog, 17th Edition.

New geared beam type pumping machines, Bethlehem Series 50 pumping units, have a new adjustable counterbalance crank which enables one man on the ground, with one wrench, at one setting of the cranks, to adjust all four weights in a few minutes. This is made possible by cast gear racks, and by movable weights with gear pinions.

Counterbalance changing is accomplished by setting the cranks horizontal toward the samson post and setting the brake, loosening the four clamp bolts in the weight by means of the wrench furnished; turning the wrench end-for-end and placing it on the wrench square provided on the pinion in the weight and moving the weight to the new position. The weight is then clamped into place and the procedure repeated until all four weights are positioned.

The unit has a step-down walking beam to provide a lowered tailboard

bearing position. This, in conjunction with a set back bear box, provides for equal pitman angularity in either direction of crank rotation.

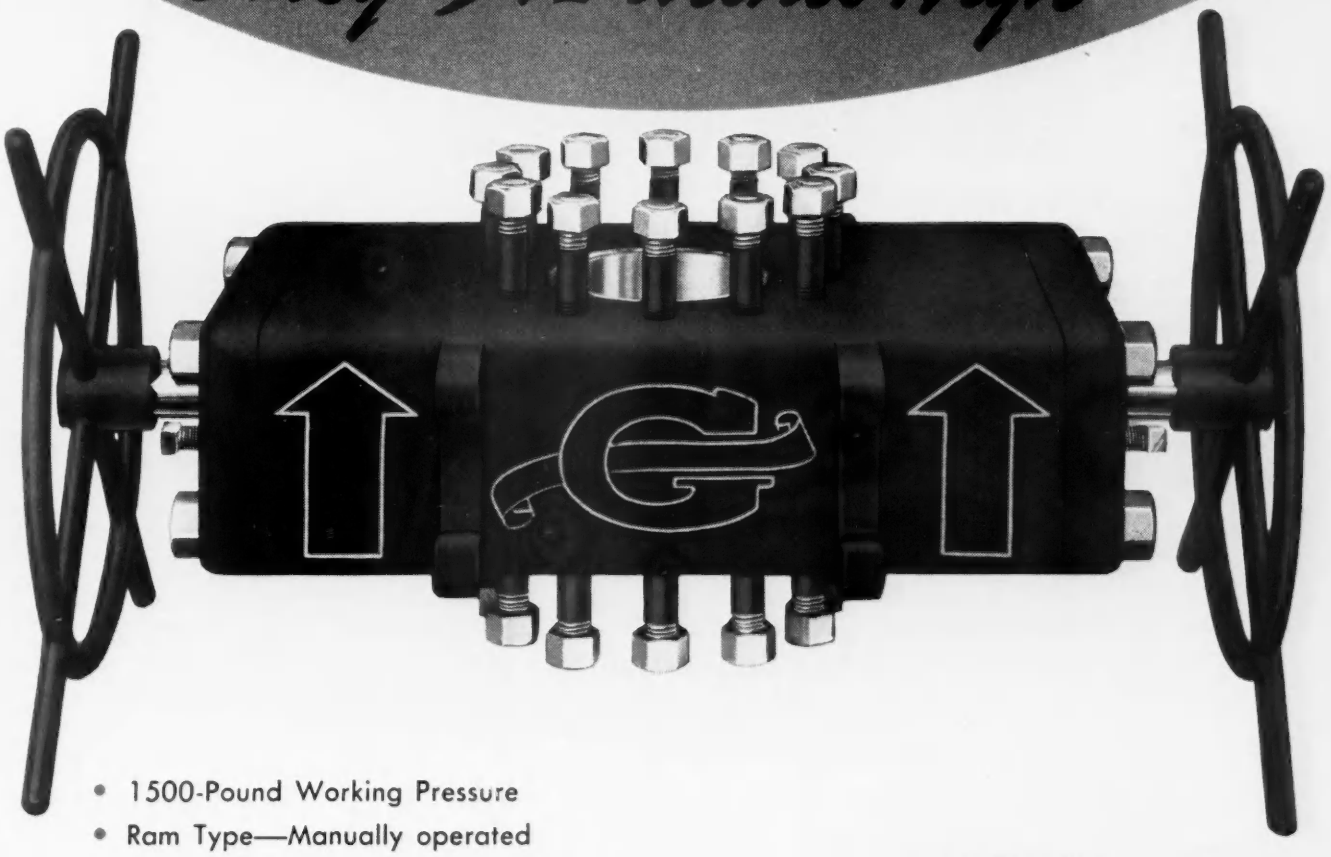
Sampson post heights have been increased over the Series 40 units, and are of four-legged design, rigidly braced, jig assembled and welded. The same type gear reduction boxes are used.

The Series 50 line is available in all API sizes ranging from 40,000 inch-pounds to 320,000 inch-pounds torque rated reducers which are fitted to structures with API ratings of 9000 pounds to 29,000 pounds.

For additional information, write Bethlehem Supply Company, 21 East Second Street, Tulsa 3.

GUIBERSON NEW BLOWOUT PREVENTER

Only 9½ inches High*



- 1500-Pound Working Pressure
- Ram Type—Manually operated
- Self-Centering Pack-off around tubing
- Up through 9" opening to pass drill bits and large tools
- Designed for work over operations and small hole drilling
- Quick-Change Rams—Only 4 nuts each end

*Over-all height less studs

SAFE THAN SORRY — GUIBERSON — BETTER BE

SOLD BY LEADING OIL FIELD SUPPLY STORES EVERYWHERE

Established 1919

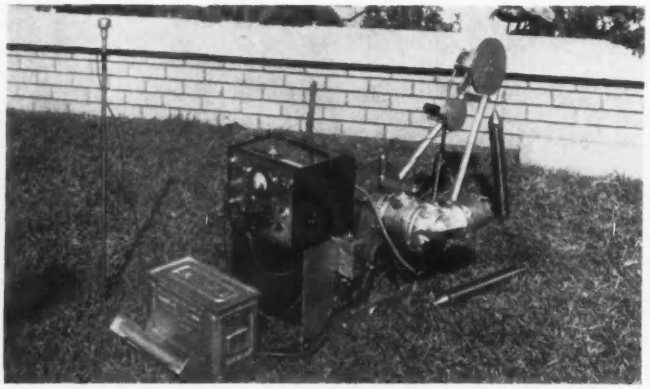
THE GUIBERSON CORPORATION

Dallas, Texas U. S. A.

OTHER NEW AND IMPROVED EQUIPMENT

172—Well Logging Unit

A new type of well logging unit is capable of logging shallow structures to 1500 feet. Its recorder gives straight line direct inking chart recordings. Width of the chart is four inches, in a 105-foot roll, graduating ten to the inch. Chart drive is reversible so that log can be made going in or coming out of hole.



The unit records mono-electrode resistance, and has a sensitivity of 20, 50 or 100 ohms for the full width of the chart. The chart moves one inch for 20 feet of electrode movement.

The unit may be transported in the trunk of a car, as weight of the recorder is 25 pounds, and of the 1500-foot capacity reel assembly 85 pounds.

For additional information, write Technical Instrument Company, 3732 Westheimar, Houston.

173—Packings

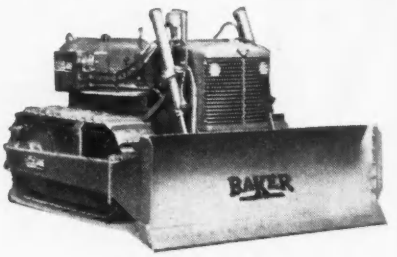
A new series of molded, sheet, braided and twisted packings has been designed exclusively for oil country service. Included are valve cap and cylinder head gaskets for all slush pumps, with each gasket stamped for the pumps it fits. There are also Otiseal liner packings, Otis Tell-Tale liner packing assemblies and washpipe packing.

For additional information, write Otis Equipment Company, P. O. Box 7326, Houston.

174—Bulldozers

New Baker bulldozers and gradebuilders for Allis-Chalmers HD-5 tractors are hydraulically controlled through twin hydraulic cylinders mounted at the front of the engine frame. Overhead height of the mounting is less than for the tractor itself.

Both bulldozer and gradebuilder are mounted close to the radiator so as to maintain tractor balance and stability and utilize the full power of the HD-5 tractor.



For additional information, write Baker Manufacturing Company, Springfield, Ill.

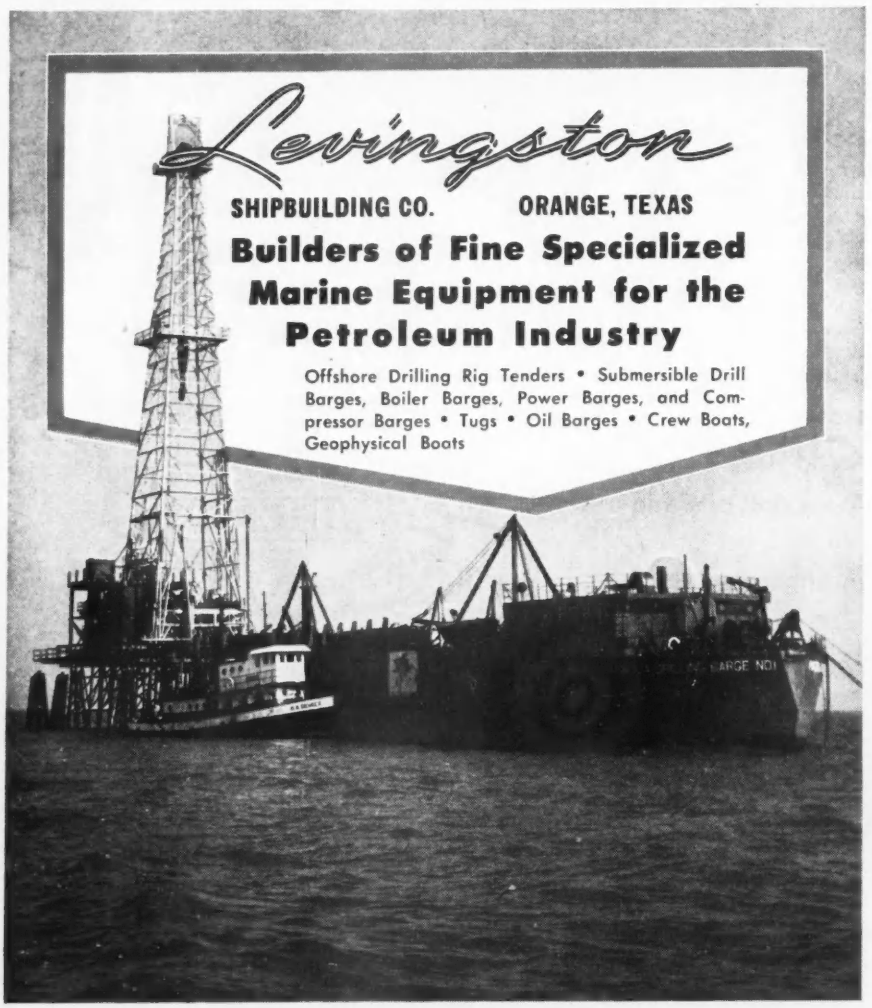
175—Excavator

Two new Lorain excavators, "Pipeliner Junior" and "Pipeliner Senior," are built especially for pipe line work.

The smaller model is in the ¾-yard class and is designed around the TL-25 turntable. The crawler is 11 feet, 8 inches over-all, with eight-foot inside span between treads.

"Pipeliner Senior," in the one-yard class, is mounted on a single speed crawler 12 feet long and 13 feet wide, with a clear eight feet inside span between treads. Hydraulic coupling power take-off prevents engine stalling under any digging conditions.

For additional information, write The Thew Shovel Company, Lorain, Ohio.


Levingston
SHIPBUILDING CO. ORANGE, TEXAS
Builders of Fine Specialized Marine Equipment for the Petroleum Industry
Offshore Drilling Rig Tenders • Submersible Drill Barges, Boiler Barges, Power Barges, and Compressor Barges • Tugs • Oil Barges • Crew Boats, Geophysical Boats

These Features Save You Money	For These Reasons	It's a Worthington—
1 Two-piece QD sheave—rim and hub separate	Mount light hub first, then slide heavier rim on tapered hub	EXCLUSIVE
2 Choice of one or two-piece assembly	Mount hub and rim separately, or loosely assemble hub on rim and slide on shaft together	EXCLUSIVE
3 Split hub	Easy to mount, even on oversized shaft	ORIGINAL
4 Clamp screw in hub	Holds hub in position on shaft while setting or removing rim	EXCLUSIVE
5 Taper-mated hub and rim	Mount easily in any position—no keyway between taper surfaces	ORIGINAL
6 Large, long pull-up bolts	Hold better and more uniformly	EXCLUSIVE
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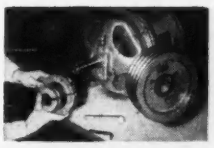
11 No realignment problem	Clamped hub holds shaft position—new rim tightens up in exact alignment	EXCLUSIVE
12 Choice of "A", "B", "C" and "D" grooves	"Tailor-made" grooves give proper belt "ride-out" for maximum life efficiency	ORIGINAL
13 I-beam spokes on driven sheave	Stronger—capable of carrying heavier load with less weight	EXCLUSIVE
14 Offset design of sheave	Reduces over-hang loads—increases bearing life	ORIGINAL
15 Worthington-Goodyear V-belts	Load-carrying cords in neutral axis reduce internal friction—each belt carries its share of drive load	ORIGINAL

How Does Your Drive Rate on the V-drive Scoreboard?

Here are 15 money-saving features of the most efficient V-belt drive. Only Worthington Multi-V-Drives give you all 15!



EASY TO GET ON

EASY TO GET OFF

YET ALWAYS TIGHT ON THE SHAFT

WORTHINGTON QD SHEAVE
—ORIGINAL TAPERED CONE-GRIP SHEAVE

Complete Range of Stock Sizes — Prompt Shipment. 853 listed stock sizes in "A", "B", "C" and "D" sections, fhp to 600 hp . . . 332 listed stock sizes of EC Cord V-belts. *Send coupon for latest Worthington QD Sheave bulletin.*

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WORTHINGTON PUMP AND MACHINERY CORPORATION
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Buffalo, N. Y. · General Offices, Harrison, New Jersey
POWER TRANSMISSION: sheaves, V-belts, variable speed drives
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The Good Right Hand of Industry

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Send latest bulletin of Worthington Multi-V-Drives.

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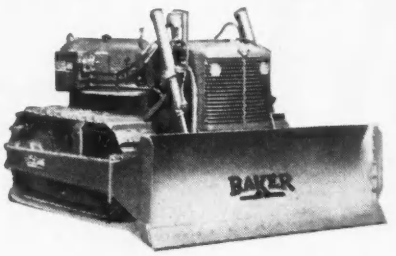

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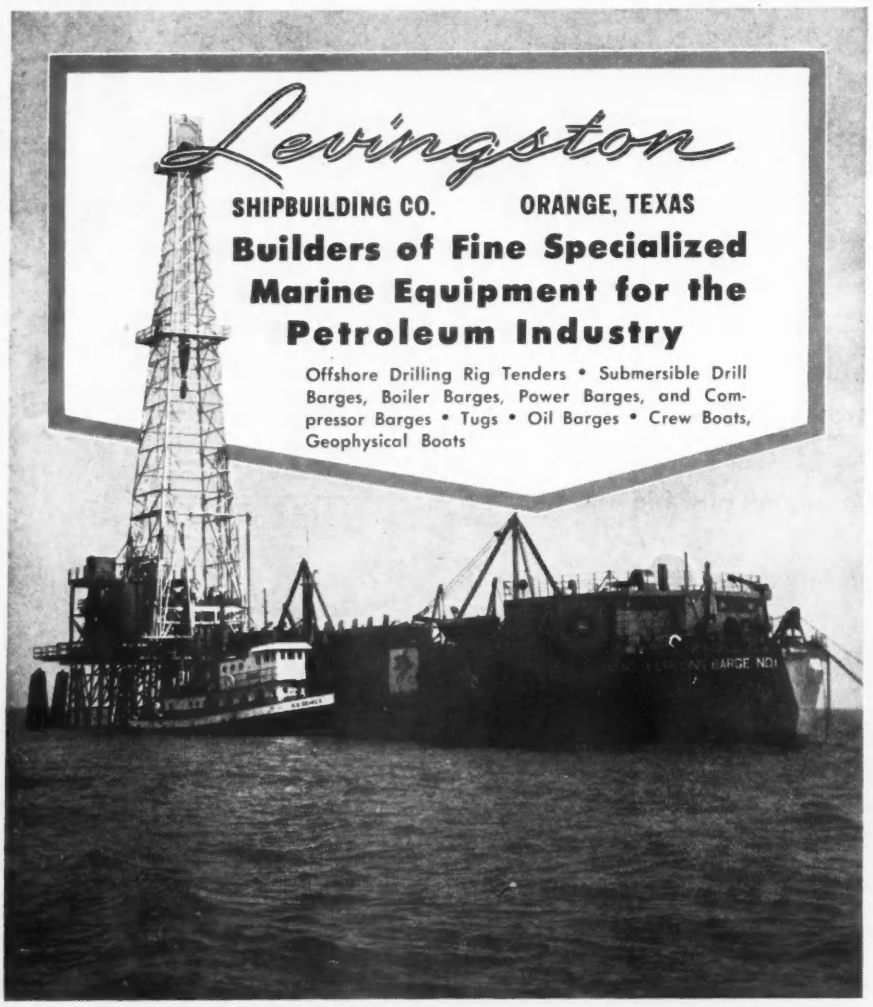
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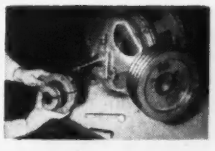

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The Good Right Hand of Industry

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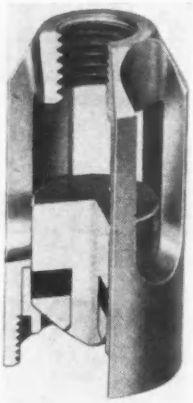
Send latest bulletin of Worthington Multi-V-Drives.

NAME.....
COMPANY.....
ADDRESS.....
CITY.....ZONE.....STATE.....

176—Twin Seat Valve

A "Twin-Seat" valve has been designed to replace the ball and seat in subsurface oil well pumps. The new valve eliminate flutter and pump slippage, producing more fluid per stroke, the manufacturer claims. Its two seats double the resistance to corrosive liquids and abrasive sands.



The valve seats steel-to-steel and is backed up with a rubber-to-steel seal-off. If the steel seat or valve are impaired by corrosive or abrasive fluids, the rubber-to-steel seal-off will perform 100 percent effectively, according to the manufacturer.

For additional information, write The Stewart Manufacturing Company, Stamford, Conn.

177—Seismograph Unit

A new miniature seismograph unit, Type PSU-11, is designed around the GA-11 amplifier. Pictured in the waterproof amplifier case, which measures 6x13x21 inches, weighs approximately 35 pounds, and contains 12 GA-11 amplifiers plus the control unit.

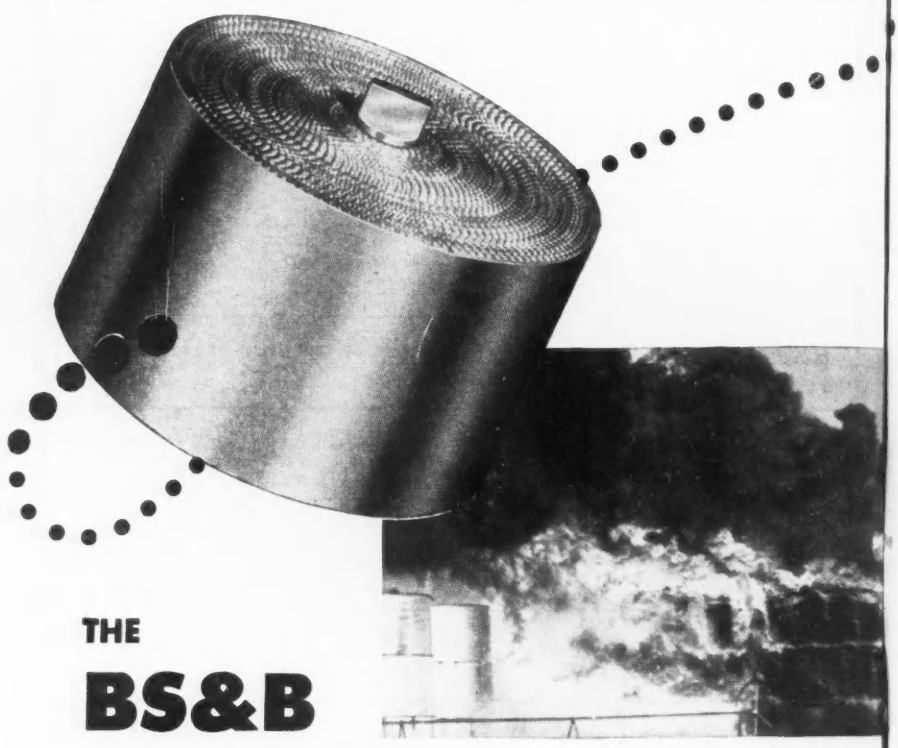
Gain of the amplifier is 120 decibels, with no preamplifiers necessary. Two-section LC filter is used for low frequency rejection, and one-section LC

filter for high frequency rejection. Amplifiers are plug-in type, and no soldering is necessary to replace them in the field.

The oscillograph has 25 traces, uses six-inch paper, and has barrel type electro-magnetically damped galvanometers. Viewing screen, built-in timing system, built-in paper knife, removable take-up magazine, and governor-controlled cranking motor are included. The complete unit measures 18x9x16 inches and weighs 25 pounds.

For additional information, write Southwestern Industrial Electronic Company, P. O. Box 13058, Houston 19.

Problem: **How to protect tanks at atmospheric pressure from fires**



THE BS&B

Combination Vent Valve—
FLAME ARRESTOR Isolates Inflammable Materials from Fire

Note the tanks in the lower left of the above fire scene photograph. These tanks and valued contents were saved because they were equipped with BS&B Vent Valve FLAME ARRESTORS. The device acts instantly to eliminate tank fires.

The BS&B Vent Valve FLAME ARRESTOR, may enable you to receive a reduced insurance rate. It will pay you to investigate.

Black, Sivalls & Bryson, Inc.
Special Products Division
Kansas City Tulsa Oklahoma City

FREE CATALOG FOR YOU

This new BS&B Catalog for the Chemical Industry will give you the complete story on Vent Valve-Flame Arrestors and acquaint you with many other BS&B products designed to give you extra protection for your property and to safeguard the lives of your personnel.

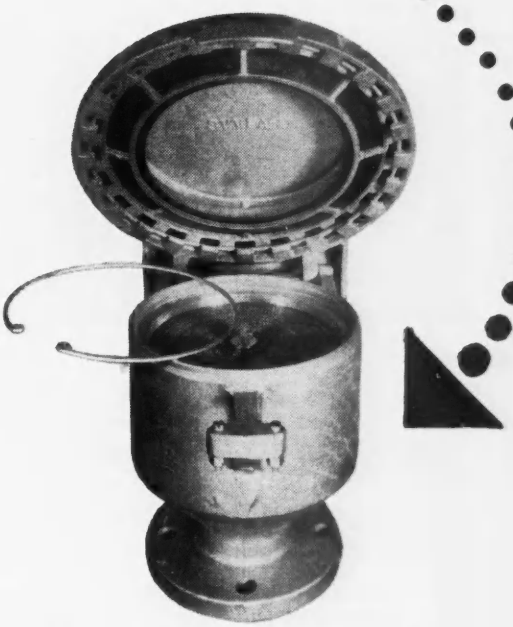
Solution: COMBINATION VENT VALVE

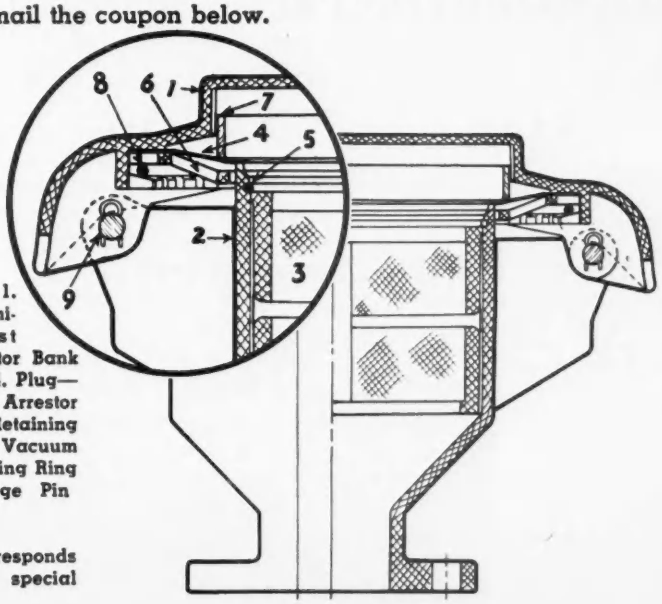
BS&B flame arrestor

The BS&B FLAME ARRESTOR is a neat, compact unit which becomes an integral part of the BS&B VVFA Vent Valve. It adds the advantage of fire control. The Arrestor bank prevents propagation of flame into your tank. Valve is designed to function under internal pressure or vacuum. Any volatile material held in tank storage without proper protection is a potential bomb.

Flame cannot penetrate the honey-combed construction of the all aluminum BS&B FLAME ARRESTOR bank. The BS&B Vent Valve FLAME ARRESTOR operates automatically and requires no hand snuffing or manual attention. It is quickly removed . . . for cleaning or replacement.

Chemical plant executives, engineers and superintendents are especially invited to investigate the new BS&B Vent Valve FLAME ARRESTORS. We will be glad to show the proven protection these units give. There is no cost or obligation . . . just mail the coupon below.





SPECIFICATIONS: 1. over—Cast Aluminum. 2. Body—Cast on. 3. Flame Arrestor Bank Rolled Aluminum. 4. Plug—nthetic Rubber. 5. Arrestor ring—Steel. 6. Retaining ng—Aluminum. 7. Vacuum ng—Steel. 8. Retaining Ring ring—Steel. 9. Hinge Pin Stainless Steel.

OTE: Bolt circle corresponds 150 ASA unless special illing specified.

Pressure-Vacuum Vent Valve Flame Arrestor 2, 3, 4, and 6 inch sizes; internal opening pressure (ounces) minimum 0.5, maximum 1.75, and vacuum opening (ounces), 0.5. **Pressure-Vacuum VVH Vent Valve** (Does not include Arrestor bank) Used as secondary relief valve or, as primary relief valve where Arrestor bank is not required.

Valve Inch Size	Opening Pressure Ounces		Vacuum Opening Ounces
	Minimum	Maximum	
2	3.2	16	0.5
3	3.2	16	0.5
4	2.5	16	0.5
6	2.5	16	0.5
8	2.0	16	0.5
10	2.0	16	0.5
12	2.0	10	0.5
16	2.0	8	0.5
20	2.0	6	0.5
24	1.5	4	0.5

NOTE: Pressures in this table are for cast aluminum cover, and they will differ from other metals. Pressure ratings require a manufacturing tolerance of plus or minus 5 per cent. Vacuum opening can be increased.

FREE ANALYSIS WITHOUT OBLIGATION

Jim Myers, Sales Manager will have a BS&B engineer analyze your volatile material tanks and submit suggestions to you WITHOUT COST OR OBLIGATION. Mail coupon or call GRand 6700, Kansas City, Mo. Do it now!

Black, Sivalls & Bryson, Inc., 720 Delaware
Section 2-245, Kansas City, Mo.

☐ Please send me new SAFETY HEAD catalog when ready.

☐ Please have a BS&B SAFETY HEAD engineer analyze my relief problem, without cost, or obligation to me.

Name_____

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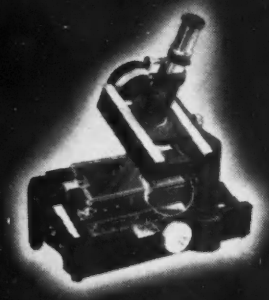
City_____ Zone_____ State_____

BS&B FLAME ARRESTOR

For Reading Bottom Hole Pressure Charts



For accurately reading bottom hole pressure gage charts. One inch travel on pressure scale readable to 0.0001 inch. Sixty power microscope. Four inch travel on time scale read with scale and vernier. Shadowless illumination. Available with 2 inch or 50 mm travel of microscope.

CIMCO

COLEMAN INSTRUMENT

and Manufacturing Company

716 SOUTH TROOST TULSA, OKLAHOMA

Standco

NO-SMOKE

STANDCO BRAKE LINING

Stands the gaff and gets the job done without scoring brake rims. See pages 3973-3978, Composite Catalog.

Standco Brake Lining Co.

HOUSTON

HOUSTON LABORATORIES

Analytical and Consulting Chemists

Hydrocarbon Gas Analyses, Reservoir Equilibria Studies for Crude and Condensate well, Waters, Brines, Corrosion and Industrial Analyses.

Phone CApitol 1319, Box 132, Houston, Texas

IT'S NEW PELCO ..IT'S TOO!

Be Sure to Check

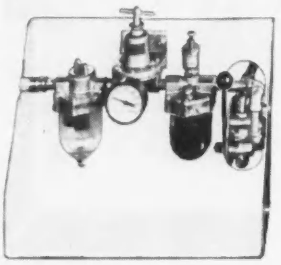
The Trading Post

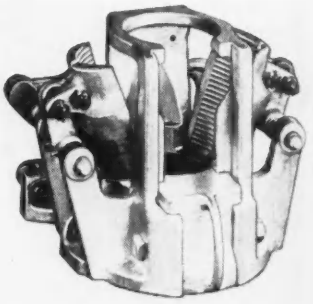
PAGE 306

OTHER NEW EQUIPMENT

178—Air-Powered Tubing Spider

A new air-powered tubing spider makes it impossible to drop a string of tubing when the slips are in position against the tubing, as the pressure exerted causes the slips to ride the pipe at all times. The control valve is remote and the action of the slips is automatic and positive when the valve is worked.





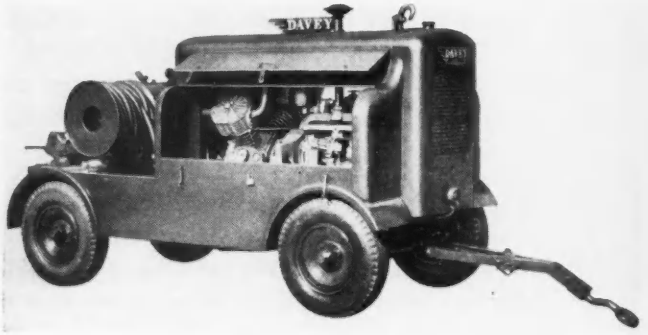
Pictured at left is a portable metal case, with top removed, which houses a filter, pressure regulator, lubricator, and control valve. For permanent installation the valve is designed so that it may be installed at the hoist operator's position. A foot-operated valve with guard is available.

At right is a front view of the spider with the slips shown in their upper, or retracted, position. The actuating air cylinder is mounted on the back side of the spider body.

For additional information, write Advance Oil Tool Company, 2315 Carroll Park South, Long Beach 14, Calif.

179—Heavy-Duty Compressor

A new line of custom-built heavy duty compressors, Air Chief AIRistocrats, are manufactured on special order, with production limited to 100 per year in 105 and 210 cubic feet per minute sizes and 50 per year in 160 and 315 cfm sizes.



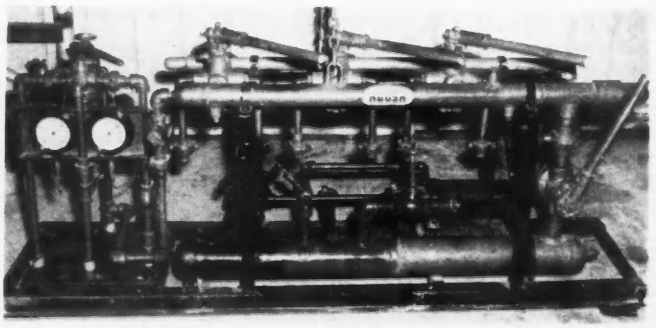
The compressor has extra heavy welded steel, vibrationless frame, with fenders and locking gas cap. It has electric starting, hand parking brakes, and electric service brakes which can be connected to the braking system of any vehicle used to tow the compressor.

Two hose reels, each of 150 feet capacity, are furnished. Tires are 7:00 x 16, mounted on heavy duty truck wheels. Three lifting hooks, one front and two rear, facilitate attachment of slings for transporting by crane.

For additional information, write Davey Compressor Company, North Water and Cook streets, Kent, Ohio.

180—Blowout Preventer Control Manifold

A blowout preventer control manifold provides a compact distributing system for steam, water and high pressure operating fluid to the preventers. The manifold is skid-mounted on a unit 30 inches wide and 10 inches long with a lift chain at the center of gravity.



Included is a platform for mounting the hydril control manifold, which may be connected permanently to the high pressure system and transported in a protected position. The four-way valves for control of the ram type preventers are installed in any number with outlets manifolded for return of operating fluid to the reservoir.

High pressure connections into the unit are provided for boiler feed pumps, mud pumps, hand pump, auxiliary floor pump, steam or the hydril accumulator.

For additional information, write Portable Bridge and Equipment Company, Gulf Building Addition, Houston 2.

Arrow Drilling Company gets extra ton-miles WITH J&L DRILLING LINE

J&L STEEL

Clean to Handle and Clean on the Rig, J&L Drilling Line Means Fewer Line Changes and Less Shut-Down Time in the Long Run

When you have as many rigs working as Arrow Drilling Company, the selection of the right drilling line is mighty important to successful operation. Frequent shut-downs to replace lines are expensive—both in the cost of line and in the cost of down-time. A broken line brings disaster.

Arrow Drilling Company uses J&L drilling line because they can count on it for a nice run in round-trips. It helps their rigs drill deeper with maximum efficiency. And it keeps the cost of line at a minimum.

The crews on Arrow rigs like J&L drilling line too, because it is lubricated with an exclusive, long-lasting Bronzlube that is clean to handle, doesn't run out when the line gets warm.

The next time you order drilling line, why not try J&L? With J&L representatives and warehouses in every part of the oil country, you can depend on prompt delivery and courteous service.

Above Right: Rig 17 shown here reached 10,624 feet after 152 days of continuous operations. J&L Drilling line on this rig has made more than 150 round trips and is still in good condition.

Above Left: Going back in after drill stem testing distillate on Arrow Drilling Co. Rig 17 in Lindsay Field, Garvin County, Oklahoma. In the foreground are Engineer S. E. Hudson, and Crewmen W. E. Hites and K. W. Keenan. Supervising are Tool Pusher L. E. "Mac" McConnell (left), and Driller W. W. "Woody" Moore. Derrickman (not shown) is Ray Satterwhite.

JONES & LAUGHLIN STEEL CORPORATION

From its own raw materials, J&L manufactures a full line of carbon steel products, as well as certain products in OTISCOLOY *and* JALLOY *(hi-tensile steels).*

PRINCIPAL PRODUCTS: HOT ROLLED AND COLD FINISHED BARS AND SHAPES • STRUCTURAL SHAPES • HOT AND COLD ROLLED STRIP AND SHEETS • TUBULAR, WIRE AND TIN MILL PRODUCTS • "PRECISIONBILT" WIRE ROPE • COAL CHEMICALS

Jones & Laughlin Steel Corporation
417 Jones & Laughlin Building
Pittsburgh 30, Pennsylvania

I am interested in using the right wire rope for the job. Please send me a free copy of your handbook "Wire Rope is a Machine."

Name_____

Company_____

Address_____

181—Photogrammetry

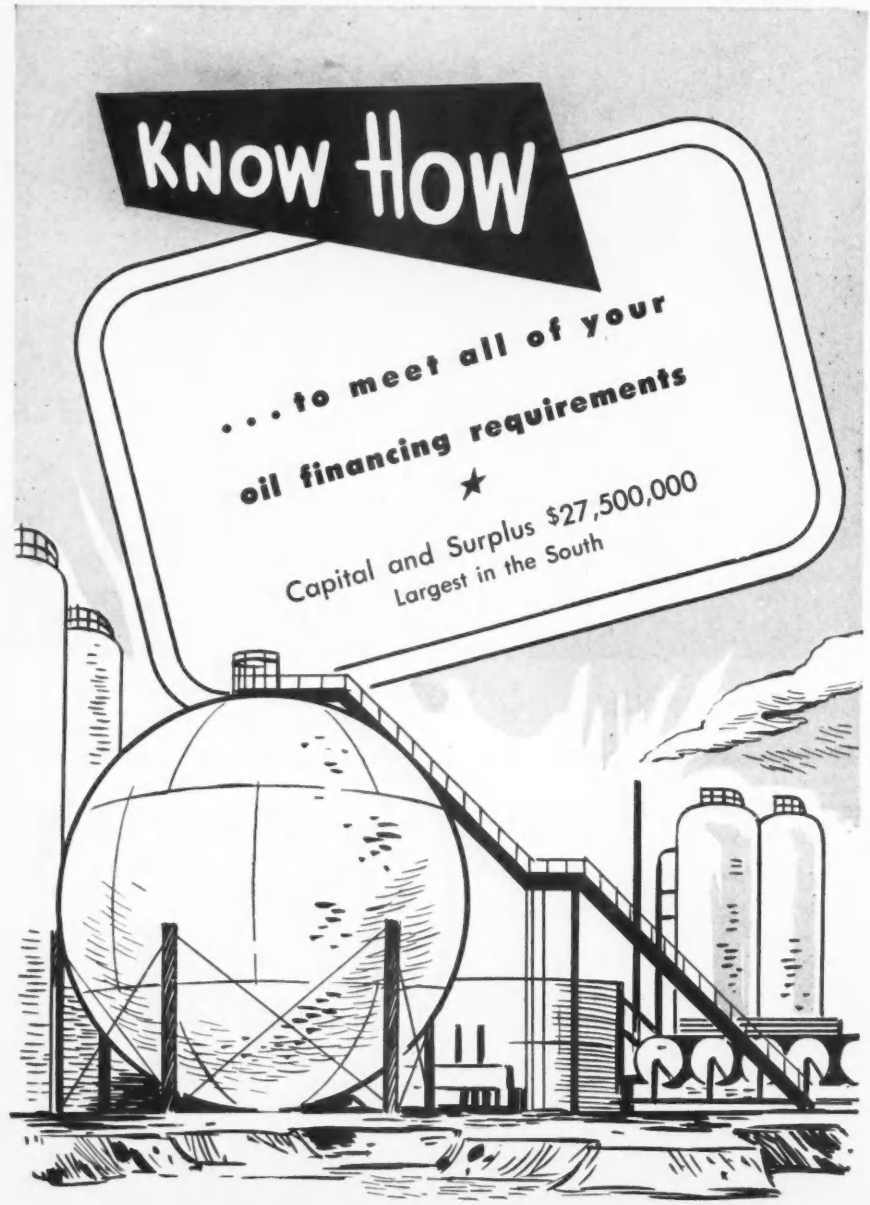
Photogrammetry, the science of obtaining reliable measurements by means of photography, is described in all its wide applications in a new brochure entitled, "Air Speeds to Your Map Needs." The 36-page booklet illustrates with aerial photographs and their reductions to desired type maps the practical applications of aerial photogrammetry. Procedures in preparing mosaics, topographic and geologic maps are presented along with some of the equipment used in this special map making technique.

For a copy of this brochure, write Jack Ammann Photogrammetric Engineers, 829-31 North St. Mary's Street, San Antonio 2.

182—Drilling Rig

An interim bulletin, 12 pages, describes the new Ideal Type T-16 Consolidated Rig for shallow drilling and workover jobs. Included are design details, specifications, engine performance charts, and drawings with dimensions and shaft speeds.

For a copy of this bulletin, write The National Supply Company, Box 899A, Toledo, Ohio.



REPUBLIC NATIONAL BANK
of DALLAS

MEMBER FEDERAL DEPOSIT INSURANCE CORPORATION

183—Pressure Vessels

Information on Multi-Layer pressure vessels is being published in a series of six bulletins, the first of which, Bulletin V-52, "Multi-Layer Manufacture and Assembly," has been released. The others will discuss general history, research, design and engineering, penstocks and specifications.

For copies of these bulletins, write A. O. Smith Corporation, 3533 North 27th Street, Milwaukee.

184—Chemical Injector

Description and specifications of the new McFarland Chemical Injector are contained in a new fully illustrated, two-color, four-page folder.

For a copy of this folder, write McFarland Manufacturing Company, 1630 Roberts Street, Houston 3.

185—Rock Bits

A new four-page folder illustrates and describes the complete line of Globe patented rock bits designed for deeper, high-speed operation.

For a copy of this folder, write Globe Oil Tools Company, Los Nietos, Calif.

186—Pulsation

A new technical research bulletin deals with pump pulsation problems, the most common cause of pipe line and hydraulic system failure. Included are illustrations of typical pumps, flow diagrams of their output, and formulas for determining the sizes of Greer Hydro-Pneumatic Accumulators necessary to obtain optimum dampening of pressure surges.

For a copy of bulletin 500, write Greer Hydraulics, Inc., 454 18th Street, Brooklyn, N. Y.

187—Narrow Valves

A 12-page, two-color catalog introduces a new line of 50-pound narrow face-to-face valves, designed particularly for rugged hydraulic service. Various types of valves and controls are described and illustrated.

For a copy of this catalog, write R-S Products Corporation, Wayne Junction, Philadelphia 44.

188—Liner Pullers

A new 12-page catalog gives descriptions and prices for Red Devil liner pullers for slush pumps. The liner pullers are made in two types: the "Universal Type" for conventional slush pumps and the "Expanding Grip Type" for thin wall liners. They are available for all makes.

For a copy of Catalog P-122, write Oil Well Manufacturing Corporation, 6000 South Alameda Street, Los Angeles 1.

Measure any other pressure control equipment against the advantages of the

SHAFFER COMBINATION ROTATING BLOWOUT PREVENTER AND STRIPPER

There's only one way to fully appreciate the unequalled pressure protection you get in the Shaffer Combination Rotating Blowout Preventer and Stripper . . . that's to measure—point-by-point—*any other* equipment on the market against the unique operating features incorporated into this unusually effective unit. For example . . .

MEASURE FOOL-PROOF DEPENDABILITY!

The Shaffer Combination Rotating Blowout Preventer and Stripper maintains its leak-proof seal *continuously* while pipe is in the hole. There is nothing to *operate*, nothing to *remember*, nothing to *forget*, when sudden pressure emergencies occur. The unit is *always* sealed off around the drill string, ready for instant protection against pressure blowouts!

MEASURE ALL-AROUND ADAPTABILITY!

The Stripper Rubber seals off around *any shape or diameter* in the drill string (excepting such abnormally large diameters as the bit and reamer). Automatic expansion and contraction accommodates any type of kelly—square, hexagonal or octagonal—as well as couplings, tool joints, subs, drill collars and pipe, whether flush, coupled or upset. *No special equipment or special pipe is needed with this unit!*

MEASURE TROUBLE-FREE OPERATION!

Since the Stripper Rubber rotates *with* the kelly—not around it—there is virtually no wear on the rubber. Patented steel reinforcing latches provide an expandable steel barrier that prevents extrusion of the Stripper Rubber either by high pressures or by pulling large diameters through it—yet maximum elasticity of the rubber is maintained. In addition, the bearing assembly upon which the unit rotates has separate thrust and radial bearings to withstand the severe loads occasioned by modern drilling practices . . . and the bearings are lifetime prepacked with heat-resisting lubricant. Maintenance is negligible!

MEASURE OPERATING SIMPLICITY!

When the drill string is in the hole, adjustment to different diameters and shapes in the string is *completely automatic*—no manual operations are necessary. When running large tools such as bits or reamers through the unit, simply pull a spring latch, rotate the bonnet 1/6 turn and the entire internal mechanism as a unit can be withdrawn to permit removal of the tools. Simply reverse the operation when going back into the hole.

MEASURE SPACE-SAVING COMPACTNESS!

The Shaffer Combination Rotating Blowout Preventer and Stripper is so engineered that vertical height in the drilling riser is kept at a minimum. It can be installed even under the most difficult space limitations. Moreover, flow connections built directly into the body eliminate need for spools or other equipment for overflow connections.

These and other unique advantages of the Shaffer Combination Rotating Blowout Preventer and Stripper—plus the *quality* that is built into every part—make it the most *efficient*, most *versatile*, most *practical* pressure control unit yet developed. Investigate and compare it with *anything* else on the market!

Write for complete details on the Shaffer Combination Rotating Blowout Preventer and Stripper—or see your nearby Shaffer representative.

Send for your free copy of the new Shaffer Catalog. See pages 4433 to 4496 of your 1950 Composite Catalog for helpful data on the complete Shaffer line of field-proven products!

27 YEARS OF OIL TOOL LEADERSHIP

SHAFFER

HIGH PRESSURE DRILLING AND CONTROL EQUIPMENT • FISHING TOOLS THAT EXCEL

SHAFFER TOOL WORKS, Brea, California • California Service Shops: Santa Fe Springs and Taft
HOUSTON, TEXAS, 6006 Navigation Blvd. • ODESSA, TEXAS, 1925 West Second Street
OKLAHOMA CITY, OKLAHOMA, Acme Oil Tool Company, 1001 S. E. 29th Street
CASPER, WYOMING, Shaffer Tool Works, Post Office Box 1788
EXPORT SALES OFFICE: Shaffer Tool Works, 500 Fifth Avenue, New York, N. Y., U.S.A.

189—Separators

Three new bulletins describe and illustrate Peerless oil and gas separators. The four-page, two-color Bulletin 201 explains entrainment, foaming, and fabrication of oil and gas separators, and special design separators.

Photographs and cross-sectional drawings illustrate High Pressure oil and gas separators in Bulletin 203, which also includes oil capacity tables and gas capacity tables.

Bulletin 204, Hi-Surface horizontal separators, discusses a solution to the problem of the separation of foaming crude oil and separation of oil at high pressures.

For copies of these bulletins write Peerless Manufacturing Company, P. O. Box 7193, Dallas.

190—Directional Drilling

Catalog 50 gives complete descriptions of the organization, services and equipment of the originators of controlled directional drilling.

For a copy of this catalog, write Eastman Oil Well Survey Company, Box 1500, Denver.

191—Drill Collars

A new pocket-size manual on drill collars includes reference tables, such as for weights of drill collars per foot, casing dimensions, hardness conversion, and connection identification. The booklet gives suggestions for care of drill collars, and has production photos illustrating processes in manufacturing CP drill collars.

For a copy of this manual, write Chicago Pneumatic Tool Company, Oil Tool Division, 1 N.W. 16th Street, Oklahoma City 1.

TEXLITE PORCELAIN ENAMEL
SIGNS
FOR THE OIL INDUSTRY
DANGER
HIGH PRESSURE GAS
REPUBLIC NATURAL GAS
OIL LINE
HUMBLE OIL & REF. CO.
HIGH PRESSURE
OIL LINE
GULF REFINING CO.
FOR USE OF
THE TEXAS COMPANY
AND ITS EMPLOYEES
WELL NO.
LEASE JAMES ROBINSON
SHELL OIL CO., INC.
TRESPASSING
THE TEXAS COMPANY
BOB SLAUGHTER BLOCK
(H. C. MACKEY)
TANK BATTERY NO. 8
5219 ACRES
GULF REFINING COMPANY
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SEC. NO.
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SERIAL NO.
WELL, LEASE, TANK BATTERY, CAUTION, WARNING and thousands of special signs are manufactured by Texlite for the oil industry. These porcelain enamel signs never need replacing or refinishing. Colors are brilliant and do not fade . . guaranteed against all natural elements. The initial cost is the last.
★ ANY LETTERING
★ ANY COLOR
★ ANY SIZE
★ LOW INITIAL COST
★ PERMANENT FINISH
★ NO MAINTENANCE
Write today for complete information and prices . . please furnish size and lettering required.
Manufacturers of Quality Porcelain Enamel
Gen'l Offices: 3305 Manor Way, Dallas, Texas
Branch Offices: Houston, Tulsa, New York, Detroit
TEXLITE INC.

192—Geophysics

Organization, personnel, technique, areal surveys and instruments developed and used by the company are described in a new 20-page bulletin in four colors.

For a copy of this bulletin, write National Geophysical Company, Inc., 8800 Lemmon Avenue, Dallas.

193—Diesel Engines

Series 71, two-cycle diesel engines equipped with torque converters are described in a new 24-page, four-color brochure. What a torque converter is and how it functions, and where and how it is applied are discussed and illustrated in the booklet.

For a copy of this brochure, write Detroit Diesel Engine Division, General Motors Corporation, 13400 West Outer Drive, Detroit 28.

194—Specialties

The complete line of P-B equipment is described in a new 52-page catalog. Included are mud guns and production items.

For a copy of this catalog, write Patterson-Ballagh, 1900 East 65th Street, Los Angeles 1.

195—Power Costs

Curves covering gas cost per 1000 cubic feet for dual fuel diesel and gas diesel, as well as spark ignition gas, and oil cost per gallon for oil diesel are contained in a new bulletin.

For a copy of Bulletin S-500-B-1-50, write Engine Sales Division, Worthington Pump and Machinery Corporation, P. O. Box 953, Buffalo 5, N. Y.

196—Rock Bits

Full color illustrated folders showing designs of Varel Rock Bits are printed in English and Spanish editions to serve users of Varel bits from South America to Canada. A complete line of rock bits in a wide range of sizes and designs includes three-cone, two-cone and blade type bits.

For a copy of this folder write Varel Manufacturing Company, 2109 Flora Street, P. O. Box 1306, Dallas 1.

CECIL SMITH
Statistical Editor. Specializes in statistical research and interpretation. Directs WORLD OIL's vast operations on industry statistics.

WARREN L. BAKER
Editor. Twenty-seven years in oil writing field. Formerly associate editor of Petroleum Engineer magazine. Editor of World Oil since 1935, editorial director of The Gulf Publishing Company (also Petroleum Refiner, Composite Catalog and Refinery Catalog) since January this year. Now president of the Association of Petroleum Writers and past Texas chairman for oil industry public relations committee. A frequent speaker before oil associations and societies.

HENRY OZANNE
District Editor, New York City. Twenty-seven years experience on newspapers and magazines, mostly as oil specialist. Joined WORLD OIL 1946, spent eighteen months in Middle East oil area. Formerly with National Petroleum News; Petroleum Administration for War; editor of a petroleum marketers' magazine; Petroleum Industry Research Foundation, Inc.

AL REESE
Managing Editor. Texas University graduate. In newspaper and magazine work for seventeen years. Has been specializing in oil magazine editing and writing since 1944.

GILBERT M. WILSON
District Editor, Los Angeles. Graduate UCLA, B.S. in petroleum engineering and geology. Nine years WORLD OIL staff. Prior wide field experience throughout Mid-Continent and West Coast.

RAY L. DUDLEY

Publisher. Educated at Baylor University. After more than ten years work on Texas newspapers at Dallas, Marshall, Houston, El Paso and Fort Worth, he was appointed oil editor of the Houston Post. In 1916 he became editor of the Gulf Coast Oil News, the name by which WORLD OIL was then known. In 1918 he was made president of the company, and pioneered the publication of specialized magazines and composite catalogs for the oil industry.

WORLD OIL's publisher is a director of the International Petroleum Exposition, past president and a founder of Nomads, director of Mid-Continent Oil and Gas Association, a member of API and AIMME.

ANTHONY GIBBON
District Editor, Tulsa. Formerly on company geological staff, director of drilling operations for U. S. independent, partner in drilling contracting firm. Ten years newspaper and oil industry writing.

MARK OLSON
Engineering writer. B.S. degree in petroleum engineering from New Mexico School of Mines. Wide experience in drilling and production operations in Mid-Continent areas.

L. J. LOGAN
Associate Editor. University of Texas graduate. His writings on oil economics and political developments affecting the industry are characteristically authoritative. Logan is in charge of the Current Outlook section.

MARION DENNARD
Editorial Assistant. Rice Institue graduate. Her forte is editorial layout and general writing.

ELTON STERRETT
Engineering Editor. With WORLD OIL nine years. One time executive secretary of the National Association of Corrosion Engineers, and managing editor of that association's publication. In charge of WORLD OIL's engineering-operating feature articles. A graduate mechanical engineer with ten years experience in East Texas oil fields.

SYLVIA LILLIE
Editorial Assistant. Graduate of Queens University, Canada. Assistant statistician.

JULIAN KASTROP
District Editor, Houston. University of Texas graduate, B.A. in petroleum engineering. Formerly field engineer with Humble Oil & Refining Company. Technical writer on field operations and edits WORLD OIL's popular "How To Do It" drilling, production and pipeline hints.

MARY ZUBER
Librarian. In charge of WORLD OIL's famous international oil library, which includes data on every country where petroleum is sought or produced.

RUTH THOMPSON
Editorial Assistant. Specializes on statistical records.

Written to be worth the thoughtful reading of busy oilmen

WORLD OIL

Established 1916 as The Oil Weekly

The PETROLEUM PUBLICATION Specialized for

Exploration, Drilling, Production, Pipe Line Operations and Management

Men in the Industry NEWS

R. R. Hobson, L. S. Zimmerman and **A. H. Kennerly,** pictured from left to right, have retired from active service as officers of the Houston Oil Company of Texas.

Hobson was first connected with the organization in 1902 when he joined Higgins Oil & Fuel Company, of which he was elected president and general manager in 1924. In 1926, and prior to the dissolution of the Higgins Company, he was transferred from it to Houston Oil Company of Texas and elected general manager of that company in 1933. He was elected a director in 1940, vice president in 1944, and executive vice president in 1949.

Zimmerman's first connection with the company was in 1908, when he was elected a director. He became treasurer in 1908, vice president in 1922, and a member of the Executive and Finance committees in 1922.

Kennerly joined the company as its secretary and auditor in 1910, and continued as such until his retirement. He has been a director since 1932.

•

L. A. Scholl, Jr., has been promoted to geophysical consultant on the general manager's staff, Producing department, The Texas Company, and **Roy L. Lay** has been advanced to division manager, Geophysical division, Producing department.

Scholl joined Producers Oil Company, a Texaco subsidiary, in 1916 after being graduated from the School of Mines, Columbia University. After several advancements, he was appointed manager of the Geophysical division in 1945.

Lay, a 1928 graduate of Rice Institute, joined Texaco in 1932. He was named assistant chief of the Geophysical division in 1943 and assistant division manager in 1945.

•

William M. Broderick has been named division exploration manager at Wichita, Kansas, for Anderson-Prichard Oil Corporation, succeeding M. W. Smith, resigned.

•

Virgil (Mike) Michael resigned as assistant district land man for the Houston division of Amerada Petroleum Corporation to become an independent oil operator at Jackson, Miss.

•

H. A. Grimes has been named member of the Management Committee of Creole Petroleum Corporation in Venezuela. Grimes began his career in Venezuela in 1922 as a field engineer with Creole. Since that time almost all his work has been done in Latin America.

James H. McCutchan has been elected treasurer of Creole to succeed **J. P. O'Brien,** who has retired after 20 years service. McCutchan was formerly assistant treasurer of the company.

•

Mark Olson, formerly district petroleum engineer at Rio Grande City, Texas, for Continental Oil Company, has joined the WORLD OIL editorial staff as international editor, with headquarters in Houston. Olson has had a diversified background in the oil industry, and has traveled in all U. S. oil producing states, Canada, Mexico and South American countries.

Mark Olson

A 1942 petroleum engineering graduate of the New Mexico School of Mines, Olson started his oil career with Stanolind Oil & Gas Company at Odessa, Texas, and later was with Lubri-Gel Products Company, McCracken, Kansas, as chief engineer. He is a registered professional engineer. He served in the Army during the war.

Olson succeeds **George O. Ives,** who resigned to enter government service.

•

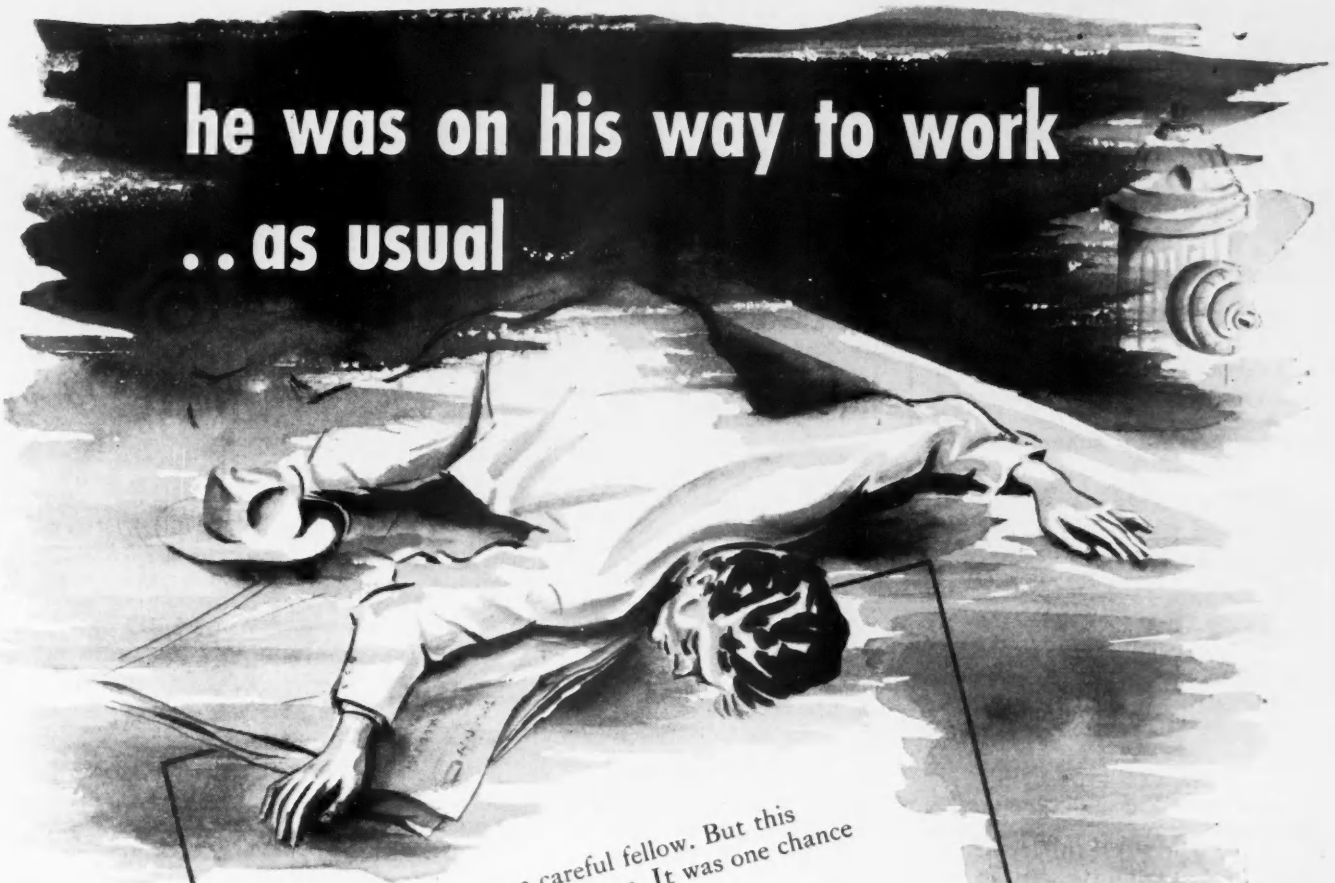
Forrest Smith has joined Carl B. King Drilling Company, Midland, Texas, as assistant general superintendent in charge of personnel. Smith, who was graduated from Texas A. & M. College in 1934, has worked as roustabout, accountant, production foreman, and drilling foreman. He served in the Army three years, and at the time of his discharge in 1945 was lieutenant colonel.

Forrest Smith

During the past two years Smith has actively participated in setting up the Employer Unit Plan of supervisory training conducted by the University of Texas, and sponsored by the AAODC. In his new capacity Smith will coordinate and supervise all personnel matters pertaining to employee-employer relationships, personnel training and safety for the drilling firm.

Gotkool
WATER CANS
& COOLERS
GOTT Water Cans are the practical way to keep drinking water cool for long periods, protected from impurities and always handy to the job. Snug fitting large removable top, strongly built to withstand rough usage. GOTT Water Coolers have extra large covers and a handy non-leaking push button faucet. Your Supply Store has them, get one today! . . . . . .
GOTKOOL WATER CAN
Made in 1½, 2, 3, 5, 10, 15 and 20 gallon sizes. (Push-Button Faucet at slight additional cost.)
GOTKOOL WATER COOLER
Made in 2, 3, 5, 8, 10, 15 and 20 gallon sizes with Push-Button Faucet.
H. P. GOTT MFG. CO.
WINFIELD, KANSAS
KEEP PURE DRINKING WATER ALWAYS HANDY

he was on his way to work ..as usual



Usually he was a careful fellow. But this morning he took a chance. It was one chance too many.

That's the way it is with most accidents . . . whether on the highways, in the home or at work. When you take a chance you take your life in your hands.

Accidents don't care whom they happen to. You are just as likely a victim as the next fellow.

But, fortunately, there is something you can do about it. BE CAREFUL. Don't risk being a statistic on the daily casualty list.

The life you save may be your own.

MR. EMPLOYER:

Because both you and your employees have a stake in avoiding costly accidents The Advertising Council asks your cooperation in posting this vitally important message on your bulletin board.

THE ADVERTISING COUNCIL, INC.
25 West 45th St., New York 19, N. Y.

A non-profit organization representing all phases of advertising, dedicated to the use of advertising in public service.

LONGER THREAD LIFE WITH Jimmie Gray COMPOUNDS

Each of these compounds is engineered to do certain jobs best. That's why you can always break the joint when you use Jimmie Gray Compounds.

MONEY BACK GUARANTEE

KANT-GALL TOOL JOINT COMPOUND

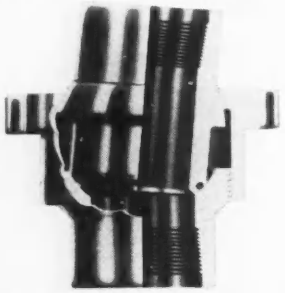
EXCLUSIVE 500-TON SPECIAL

LONG-LIFE DRILL COLLAR COMPOUND

SOLD AT SUPPLY STORES EVERYWHERE

PETROLEUM DISTRIBUTING CO.
BOX 203—HOUSTON, TEXAS
CHarter 5648

STRESS-FREE CONNECTIONS



Designed for use wherever expansion and vibration are present, the Yale "Mis-Aligning" Union provides a stress-free connection, with a positive pressure seal assured by service-proved "O-Rings."

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MEN IN THE INDUSTRY NEWS

J. L. (Slats) Latimer, left, president of Magnolia Petroleum Company, Dallas, returned to Oklahoma to receive the compliments of the state oil industry for his company. He was also made an honorary chief of the Kiowa Indian tribe. It was "Magnolia Petroleum Day" at the Oklahoma City Chamber of Commerce weekly forum, with the Oil and Gas division in charge. Latimer was given the Kiowa name of "Mau-gau-om-keah," meaning "Leader of Industry." Also honored was **Walace Hawkins,** center, vice president and general counsel of the company, who was given the name "Tou-kah-to-keah," meaning "The Great Counsellor." At right is **Jasper Saunkeah,** chief of the Kiowas, who bestowed the honors.

•

N. P. Isenberger has resigned as vice president of American Independent Oil Company and has returned to Phillips Petroleum Company, from which he was on loan.

•

James F. Breuil has been elected president of Kingwood Oil Company, Oklahoma City.

•

James W. Reid, who has been in the Legal department of Sinclair Oil Corporation for 30, years, has retired. Reid received an A.B. degree from Baker University in 1903, and an LL.B. from Kansas City School of Law in 1908. He practiced law for five years, then worked for the M-K-T Railroad, and in 1920 joined Sinclair.

H. R. McFarland, vice president, is in charge of Beacon Petroleum Company's new Gulf Coast district offices in Houston.

•

J. M. Fouts, Jr., area production geologist, Houston area, Shell Oil Company, has been transferred to the Los Angeles office as production geologist for the Pacific Coast region.

J. M. Fouts, Jr.

Fouts attended the University of Texas where he received his master's degree in geology and petroleum engineering. Following postgraduate work in 1939, he joined Shell as an engineer trainee in the Houston region, and worked in various sections of the Texas-Gulf area. He became a junior exploitation engineer, and then served in the Navy four years. He rejoined Shell and in 1948 was appointed area production geologist in Houston.

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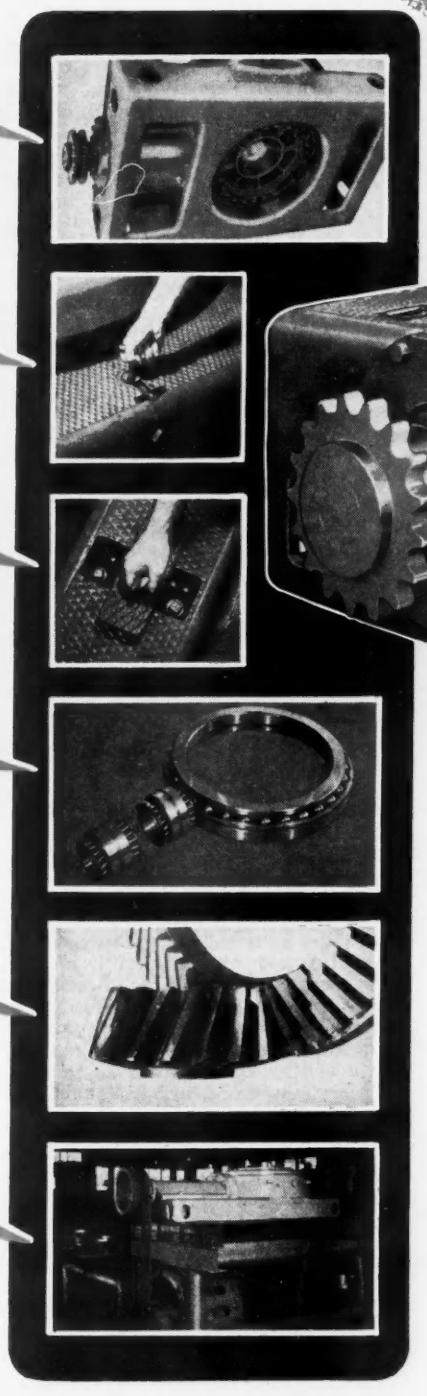

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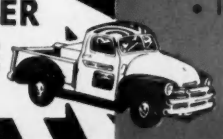

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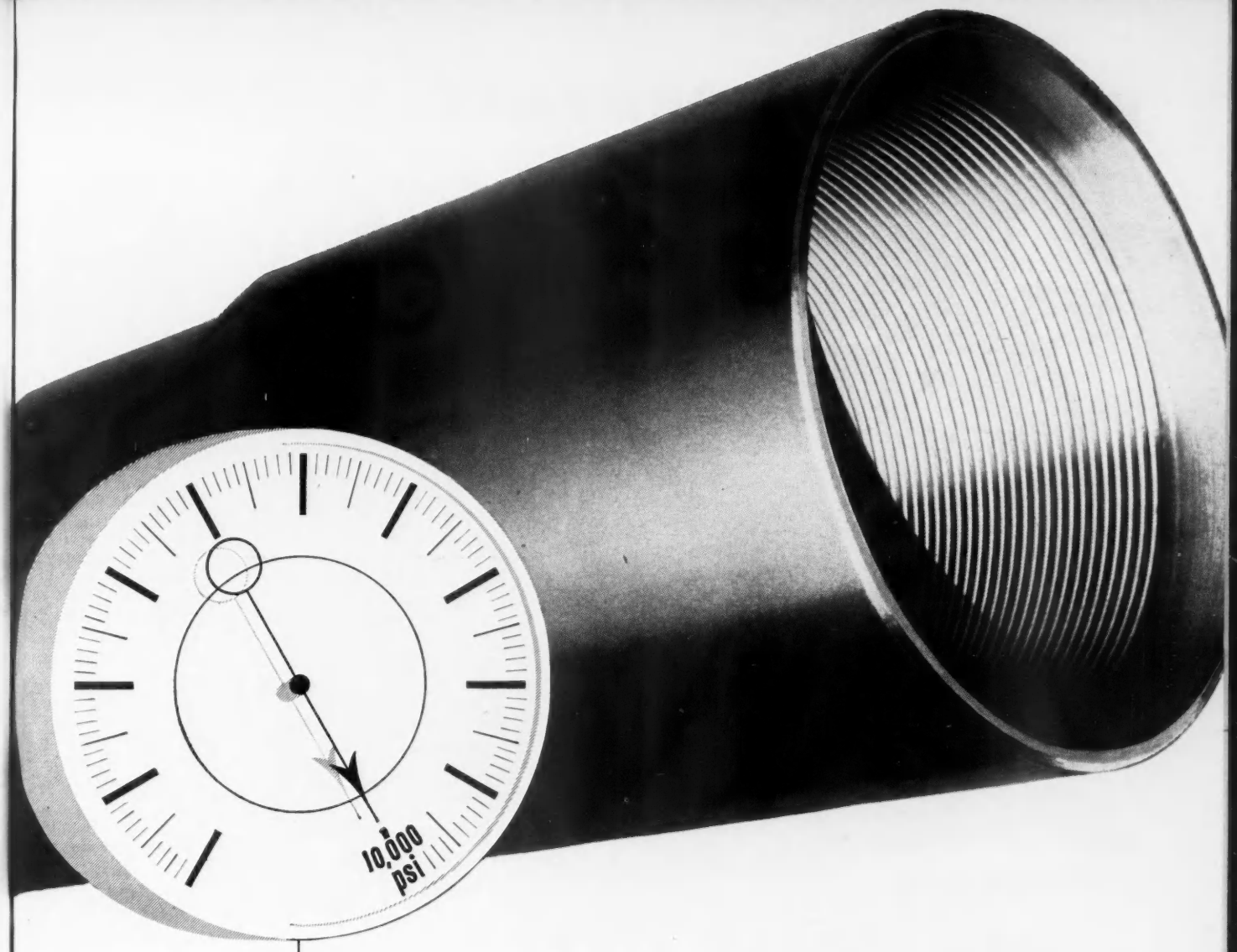
Transfers and Promotions:

Changes in Shell Oil Company's Pacific Coast Exploration department include **Addison S. Cate,** junior geologist, transferred from Long Beach, Calif., to Ventura, Coastal division; **James L. Cowell,** micropaleontologist, Long Beach, to geologist, Ventura, **Donald W. Gresser,** junior geologist, Los Angeles, to geologist, Ventura; **James D. Moore,** junior micropaleontologist, Long Beach, to Ventura. In the regional Production department, **Donald L. Jacobson,** engineer trainee, Los Angeles, was made junior mechanical engineer, Long Beach; **George S. Kukuchek,** engineer trainee, Los Angeles, to junior mechanical engineer, Bakersfield, California. In the regional Land department, **William T. R. Hunter,** senior leaseman, was transferred from Bakersfield to Calgary, Canada. **William R. Mais,** subsurface geologist at Houston, has been transferred to Oklahoma City. **Horace W. Hindry,** senior mechanical engineer, Los Angeles, has been made division mechanical engineer at Ventura. **Lyle W. Smith,** geologist at Bakersfield, became district geologist at Ventura.

John A. Diodene, district petroleum engineer, Darrow district, Production department, Humble Oil & Refining Company, transferred to Louisiana division office, replacing **Joe E. Graham,** transferred to Grand Isle district. **W. D. Clift,** senior petroleum engineer, Louisiana division office, transferred to Avery Island district as senior petroleum engineer. **S. D. McCarty,** senior petroleum engineer, Louisiana division office, transferred to Eucutta district. **D. E. Tousley,** district civil engineer, transferred from Avery Island district to Louisiana division office as senior civil engineer. **Andrew M. Gruy,** civil engineer, Gulf Coast division office, transferred to Louisiana division office as senior civil engineer. **R. L. Carroll,** district petroleum engineer, Avery Island district, transferred to Potash district. **S. F. (Sam) Moore,** chief clerk, Imogene district, was transferred to Scott & Hopper district as chief clerk. He replaced **O. A. Griffin,** transferred to the Greta district. **O. C. Ferguson,** formerly Greta chief clerk, replaced Moore at the Imogene district. **E. C. Hall,** chief clerk, Anahuac district, transferred to Lovell Lake district and was replaced at Anahuac by **H. E. Snider,** transferred from the Maurbro district. **J. R. Almond,** chief clerk, Sugarland, transferred to Maurbro.

Howard M. Walker has been promoted to assistant division superintendent of Magnolia Petroleum Company's Gulf Coast Producing division, Houston, and was replaced as assistant district superintendent of the Lake Charles district by **C. B. Swain. Kenneth L. Nelson,** assistant foreman in the Kermit Producing district, has been promoted to production foreman. **Wade L. Strange,** assistant foreman, transferred from Brownfield Producing district to Lake Charles. **Thomas E. Wright** was promoted to assistant foreman, Brownfield. **Clarence E. Rabb,** petroleum engineer, Lake Charles, transfered to assistant production foreman, Shreveport. **William C. Dougherty** transferred from Petroleum Engineering department to assistant production foreman in the Kermit Producing district. In the Petroleum Engineering department, **James R. Puckett,** district petroleum engineer, Duncan, Okla., district, transferred to Kermit as district petroleum engineer; **V. M. Leonard,** petroleum engineer, Electra district, promoted to district petroleum engineer, Duncan; **D. F. Pendley, Jr.,** petroleum engineer, Duncan, transferred to Electra as petroleum engineer; **J. Patrick Keating,** petroleum engineer, Dallas, has moved to Electra. **Joseph Neely,** formerly district geologist of the Illinois district, Mount Vernon, Ill., has been transferred to Dallas as regional geologist. **H. A. Sellin,** promoted to district geologist in charge of the Illinois district, was previously resident geologist at Tallahassee, Fla.

Sinclair Oil and Gas Company, Tulsa, announced the following promotions and transfers in the Production department: **Bill R. Roark,** petroleum engineer, from Lindsay, Okla., to Tulsa;**Charles J. Eskridge,** senior petroleum engineer, from Kiefer, Okla., to Pampa, Texas; **Oliver G. Simpson,** engineer, Oklahoma City, promoted to senior engineer and transferred to Ardmore, Okla.; **Edward H. Whitlock,** engineer, from Lindsay to Ardmore; **Ralph R. Satelo,** intermediate clerk, Tulsa, promoted to senior clerk and transferred to Arp, Texas; **Joe Mefford,** engineer, transferred from Drumright, Okla., to Corpus Christi, Texas.



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MEN IN THE INDUSTRY NEWS

Gus Kellogg

J. E. Armstrong

Gus Kellogg, superintendent of Humble Pipe Line Company's Claim and Rights-of-Way department since 1928, has retired after more than 25 years of service. He is succeeded by **J. E. Armstrong,** long-time assistant and veteran of 22 years' service.

Under Kellogg's supervision, most of the rights-of-way for Humble pipe lines were purchased. He joined Humble in 1925 as a field rights-of-way man, working out of Houston. Six months later he transferred to Cisco as division rights-of-way man, and in 1928 returned to Houston as superintendent of the department.

•

H. J. Struth, Dallas petroleum consultant, has accepted an assignment as petroleum consultant to the Venezuelan government. He is leaving immediately for Caracas, where he will organize a petroleum statistical department and will prepare an economic survey of the Venezuelan petroleum industry. His initial assignment will keep him in Venezuela for about three months, after which he will return to Dallas to resume his consulting and advisory service. Struth recently return to Dallas from New York, where he was assistant director of information for the API.

H. J. Struth

•

Theo A. Glass has resigned as district geologist for Eason Oil Company at Mount Vernon, Ill., to become an independent operator and consultant.

•

W. B. West, E. I. Martin and **Charles B. Chase,** Tulsa, retired from Gulf Oil Corporation after 39, 30 and 28 years of service, respectively.

•

Joe Teichman has resigned as geologist for The Atlantic Refining Company to become a consulting geologist in Tulsa.

•

Millard Smith has resigned as district manager in Kansas for Anderson-Prichard Oil Corporation to join Fred Anschutz and Anschutz Drilling Company at Wichita, Kansas.

How this independent businessman got his start

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This Standard of California Distributor, like those all over the West, works as an independent businessman . . . and here's how we helped him get his start.

We first turned over a going business to him with a good list of customers. We helped him learn the best methods of serving his neighbors well . . . supplied the finest products, expert engineering help in meeting tough lubricating problems, the benefits of all our laboratory research and every other practical assistance possible.

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Your Standard Distributor has his roots and interests right in his own town; the money he makes stays in your community. And because he knows local conditions through long experience and is building *his own business,* he does a better job for us by doing an outstandingly good job of serving you.

STANDARD OIL COMPANY OF CALIFORNIA

plans ahead to serve you better

Olen Lane, Lawrence E. Graham, R. G. TenEyck and **J. B. Anderson** were promoted by Continental Oil Company. Lane moves up from regional land superintendent, Pacific Coast region, to the newly created position of regional manager of exploration, Pacific Coast region. Graham goes from landman, Pacific Coast region, to regional land superintendent, Pacific Coast region. TenEyck moves up from assistant division geologist, Pacific Coast region, to assistant to the chief geologist, Houston. Anderson is promoted from geologist, Pacific Coast region, to assistant division geologist, Pacific Coast region. Lane joined the company as a leaseman in 1922 and became regional land superintendent in December, 1946. Graham joined Continental as a production clerk in 1926, became a landman in 1939, and a landman, Pacific Coast region, in January, 1949. TenEyck went to work for Continental as a geologist in Los Angeles in 1937 and became assistant division geologist in August, 1948. Anderson joined Continental as a geologist in Los Angeles in 1940, went to Shreveport as district geologist in 1948, and was transferred to Los Angeles as geologist in May, 1949.

James E. Low

Walter G. Ricketts

Walter G. Ricketts, Tulsa, has retired as general superintendent for Amerada Petroleum Corporation and has been succeeded by **James E. Low.**

Ricketts entered the oil business at 17 with the Fort Wayne Oil and Gas Company and later The Ohio Oil Company in Indiana. In 1913 he went to Oklahoma with McMan Oil Company. Before joining Amerada in 1920 he worked for Hill Oil and Gas Company and Cosden Oil Company. He supervised drilling of Amerada's first well and organized its Production department.

Low joined Amerada as a roustabout in 1928 after graduating from Southwestern University, Georgetown, Texas. He spent a number of years in West Texas and New Mexico and was transferred to the Fort Worth office in 1946 in charge of producing operations for the Southern division. He went to Tulsa in May, 1949, as assistant general superintendent.

•

Dr. Oscar E. Wagner, Jr., has resigned as research geologist for Mid-Continent Petroleum Corporation and has joined Wilcox Oil Company as geologist at Tulsa. He had been with Mid-Continent since 1942 and previously was with The Texas Company as a district geologist.

•

Anthony E. L. Morris has been appointed West Coast division geologist for D. D. Feldman Oil and Gas Company, with offices in the Holmby Building, Los Angeles. Morris was formerly a geologist with General Petroleum Corporation in Bakersfield.

The D. D. Feldman organization was directly responsible for the discovery of the Eastward extension of the Rio Vista gas field.

•

Harold L. Geis, formerly Gulf Coast division geologist for Barnsdall Oil Company, has joined R. B. Mitchell Company, consulting geologists and engineers with offices in the City National Bank Building, Houston. Geis was also previously connected with The Atlantic Refining Company.

•

James D. Wells has been appointed marine operating superintendent of the Gulf Coast division, Stanolind Oil and Gas Company, with headquarters in Houston.

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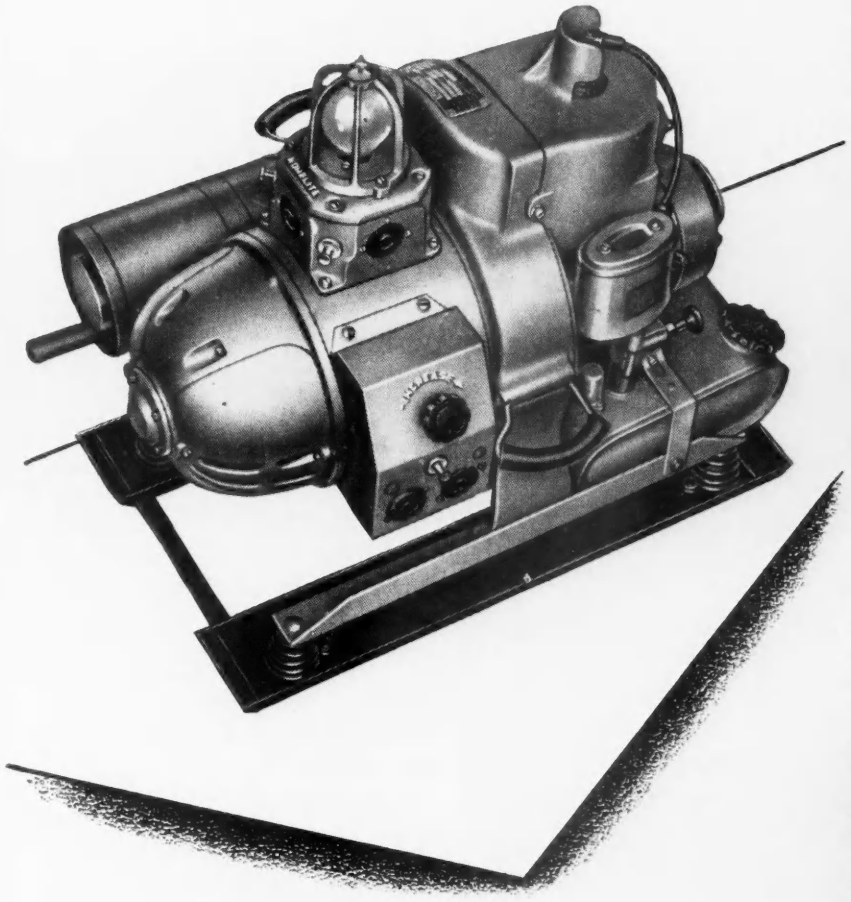

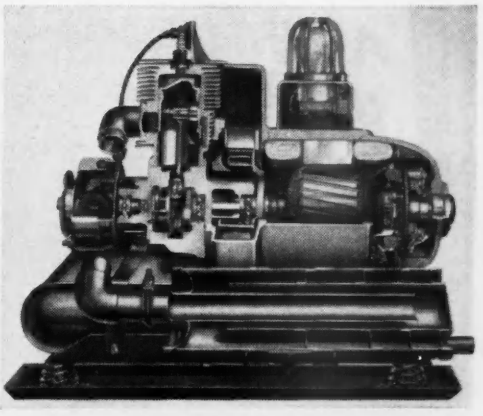

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Clyde P. Graeber, manager, Investors Royalty Company, Inc., Tulsa, has been elected president of the company, succeeding the late **Benjamin Mossman. Ross H. Rayburn** was elected vice president and **Carl B. King,** Dallas, a director.

•

Ross McCollum, president, announced that National Oil Company has acquired control of the 13-story building at Sixth and Grand in Los Angeles and has moved its headquarters office there. National is a producer in the Taft, Kern River, and Kern field areas in Kern County.

C. S. Mitchell, Bartlesville, Okla., manager of crude oil supply and transportation for Cities Service Oil Company, has been elected to the company's board of directors. Mitchell joined Cities Service as junior engineer in 1930. He is also on the directorate of Texas-Empire Pipe Line Company, Kaw Pipe Line Company and Texas-New Mexico Pipe Line Company.

•

L. H. Ralston, supervisor of purchases for Mid-Valley Pipe Line Company during its construction, has been named purchasing agent for Sohio Pipe Line Company in St. Louis.

A. P. Kramer has been advanced from assistant to the general superintendent to general superintendent of Great Lakes Pipe Line Company. He takes over part of the responsibilities of **J. B. Lawson,** vice president, who has formerly also been general superintendent.

A. P. Kramer

Before he was named assistant to the general superintendent, Kramer was supervisor of pumping stations for the northern area, which includes company lines between Kansas City and Minneapolis, and from Des Moines to Chicago.

•

J. R. Atkinson is the manager of Kingwood Oil Company's district office at Mount Vernon, Ill., recently moved from Evansville, Ind. **John Wooly** is geologist, having replaced **C. E. Siberts,** who resigned to remain at Evansville. **Paul Bushong** is landman and **Henry Wedig** is scout.

•

R. C. Keck has been appointed advertising and promotion manager of Cities Service Oil Company (Penn.). He succeeds **Robert S. Blount,** who was appointed sales manager of the Boston division.

•

F. L. White has been appointed an assistant treasurer of Socony-Vacuum Oil Company, Inc. He has been associated with the company since 1934.

•

John R. Sherman, district gas engineer, Gulf Oil Corporation, Fort Worth, has been transferred to the Executive department in Pittsburgh as staff assistant, and has been succeeded by **J. W. Cole,** formerly at Houston.

•

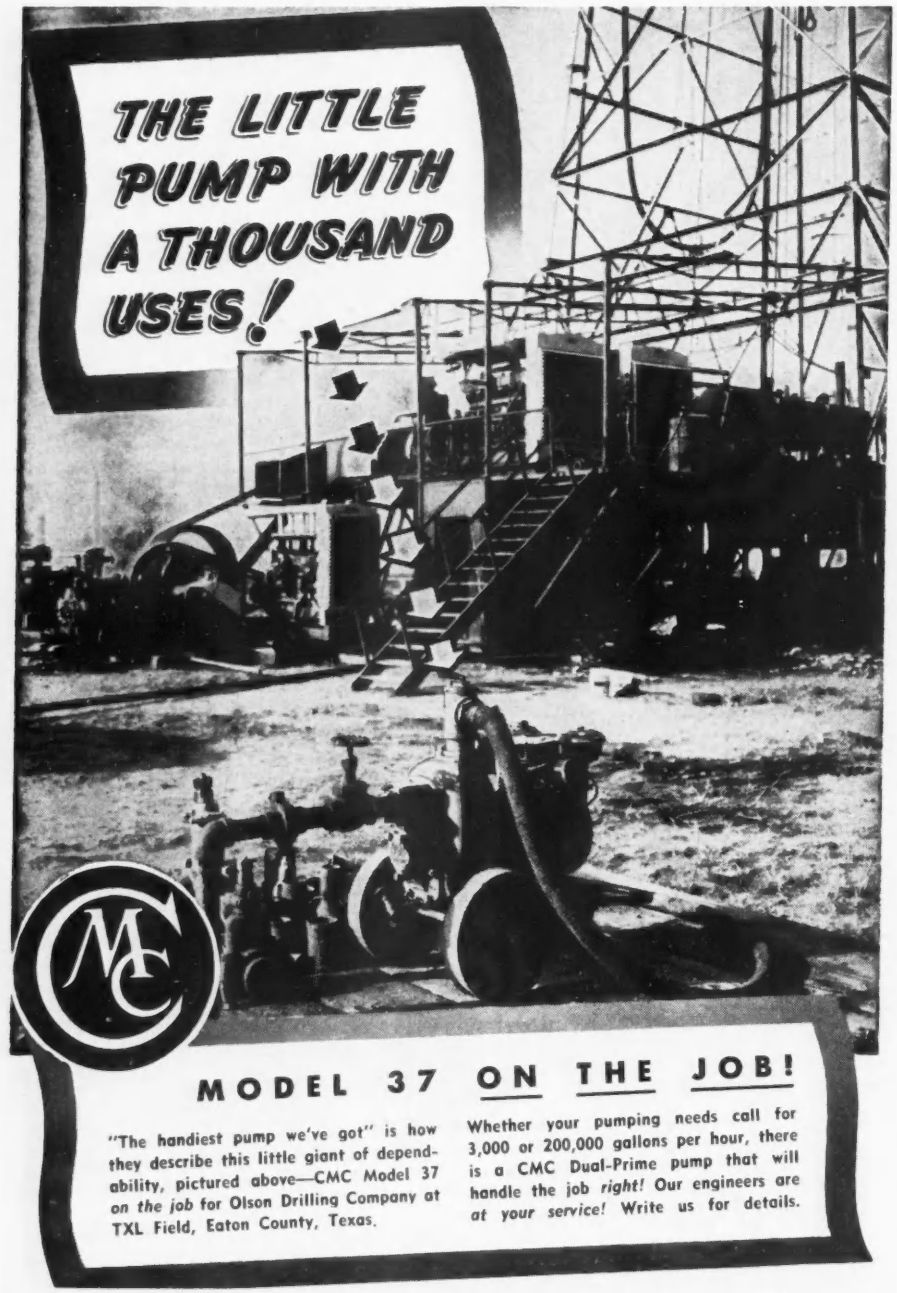
H. L. Mann, vice president in charge of gas supply for Texas Gas Transmission Corporation, will make his permanent headquarters in Shreveport. Texas Gas established its gas supply office in Shreveport last August.

•

A. J. Hartman has been appointed assistant general manager of Employe Relations for Gulf Oil Corporation. **G. L. Scott** has been named manager of the Personnel division of Employe Relations, and **W. B. Billock** manager of the Labor Relations division. All three are stationed in Pittsburgh.

•

R. L. Jodry, formerly with The Ohio Oil Company at Grand Rapids, Mich., has been named chief geologist for Rex Oil & Gas Company, Muskegon, Mich. At one time he was employed by Magnolia Petroleum Company in Louisiana and Texas.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DEATHS

David W. Sellery, 54, Casper division land man for The Ohio Oil Company, died April 9 in Casper, Wyo. Sellery joined Ohio in 1925 as a scout in New Mexico. After several years as a leaser in New Mexico and California, he was appointed Los Angeles division land man in 1941. He was transferred to Casper last year.

•

Harold Atkins, 48, secretary-treasurer of M. O. Johnston Oil Field Service Corporation, died March 31 in Los Angeles. His career with M. O. Johnston started 15 years ago when he became an accountant in the Johnston Houston office. For the past nine years he had been in the Los Angeles office.

Mills Bennett, 67, Texas Gulf Coast oil pioneer, died April 14 in Houston. Bennett entered the oil industry about 1912. He sold the Humble Pipe Line Company its first line, one which he had built in the Goose Creek field in Harris County. He was the first operator to drill successfully through a salt overhang formation on the flank of the Barber's Hill Dome, and was active in the Powell oil boom near Corsicana in Central Texas. He was the discoverer of the Lopez field in Webb County and had considerable oil holdings in Southwest Texas.

•

John Thomas O'Neil, 51, independent oil man, died March 25, after a distinguished career in petroleum, sports and philanthropy. O'Neil entered the oil business in Montana, with a brother, **Louis B. (Tip) O'Neil,** and thereafter operated in Montana, Wyoming, California and Texas. At various times he was identified with the International Refining Company, Kevin-Sunburst, Mont., the Wellington Oil Company in Texas and California, the Santa Clara Oil Company in Texas, and the Far West Oil Company in Texas and Wyoming.

•

Edward Morris Smith, 69, known throughout the oil, automotive and allied industries, died March 17 in Arcadia, La. Smith was the president of Globe Oil Tools Company, Los Nietos, Calif., and during the early 1920s had organized and directed the Emsco Steel Products and Emsco Tool Company of Los Angeles, which were later merged as the Emsco Derrick & Equipment Company. He also organized the E. M. Smith Company, later the Grizzly Manufacturing Company, in Paulding, Ohio. At one time he was the active head of more than a dozen industrial organizations.

Edward Morris Smith

•

Elbert L. Pauley, former vice president of Standard Oil Company of Kentucky, died March 29 in Los Angeles. He was the father of **Edwin W. Pauley,** Beverley Hills oil man, and **Harold R. Pauley,** president of The Petrol Corporation.

•

Lewis E. Garfield, 46, chief engineer for Hughes Tool Company, Houston, died April 21 of acute leukemia. Garfield joined Hughes in 1927, the year after he received a degree in electrical engineering from Rice Institute, and had been chief engineer since 1942. He was a native of Hurley, N. Y., but had lived in Texas since 1909, when he moved to Pasadena with his family. He was a member of the Houston Chamber of Commerce, American Society for the Advancement of Science, AIME, American Ordnance Association, IPAA, and API.

L. E. Garfield

•

Harvey A. Renschler, 82, former field superintendent for the Tulsa district of the old Prairie Oil and Gas Company, died April 10 in Tulsa. A resident of Tulsa since 1906, he retired from the oil business in 1931 when the Prairie company was merged with Sinclair Oil Company.

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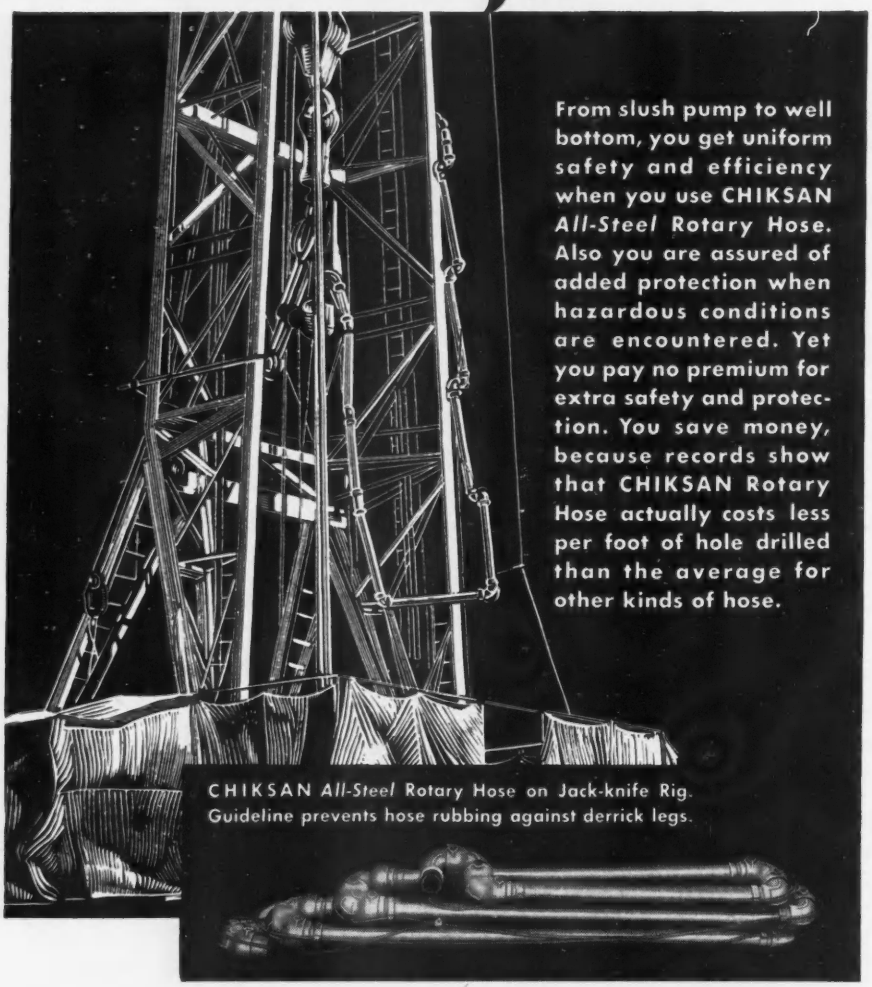

From slush pump to well bottom, you get uniform safety and efficiency when you use CHIKSAN *All-Steel* Rotary Hose. Also you are assured of added protection when hazardous conditions are encountered. Yet you pay no premium for extra safety and protection. You save money, because records show that CHIKSAN Rotary Hose actually costs less per foot of hole drilled than the average for other kinds of hose.

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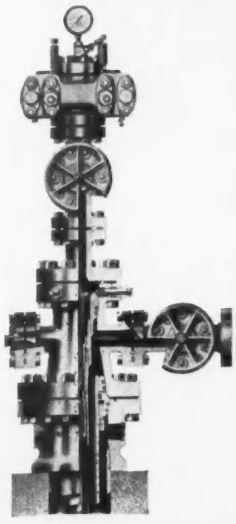
GRAY SYSTEMS OF WELL CONTROL INCLUDE THESE DEVELOPMENTS



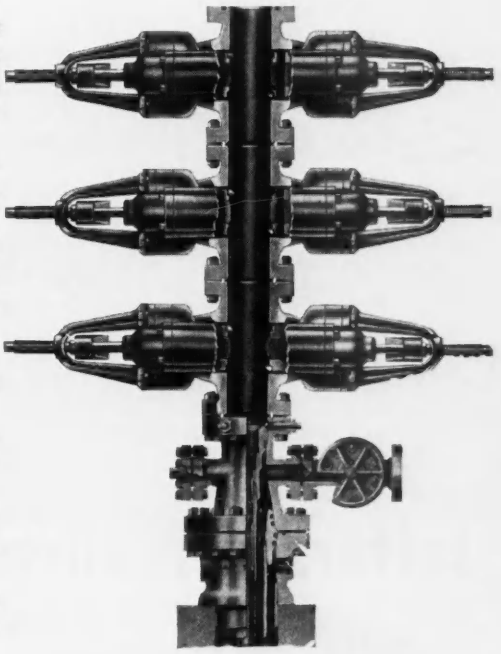
PATENT NUMBERS
2,082,413
2,117,444
2,150,887
2,241,333
2,043,428
Other Patents Pending

RELATED PATENTS
include numbers:
2,241,288
2,148,327
2,207,469
2,485,497
2,442,548
Other Patents Pending

Each feature of an "A.S.A. Series" system of well control is measured by, and must qualify in accordance with, such essential standards as:

1. Complete control throughout the performance of all operations.
2. The highest degree of simplicity, meaning the fewest number of the highest quality parts. This is the first requisite of safe well control, as hazards multiply in proportion to the number of parts used.
3. The minimizing of pressure subject areas, resulting in a proportionate reduction of operating loads. (Strict adherence to this fundamental of hydraulics.)
4. The use of relatively long-lived materials in the permanent flowing structure, especially seals. These seals are the heart of a well control system, the body being merely a housing therefor.
5. The ability to remove for repair or replacement each part when and as it has completed its full operating function.
6. Adapting the whole to the problems peculiar to a given area or a particular company. (That custom touch which is foreign to mass production practices.)

These fundamental standards are an inexorable part of each Gray Well Control study. Consistency in rigidly adhering to these standards looks toward the development of advantages while avoiding disadvantages which so often accompany inconsistent change. (A balanced structure.)



It goes without saying that a standard has no meaning except when measured by the equipment and practices established as being the measurement by which other equipment is to be weighed.

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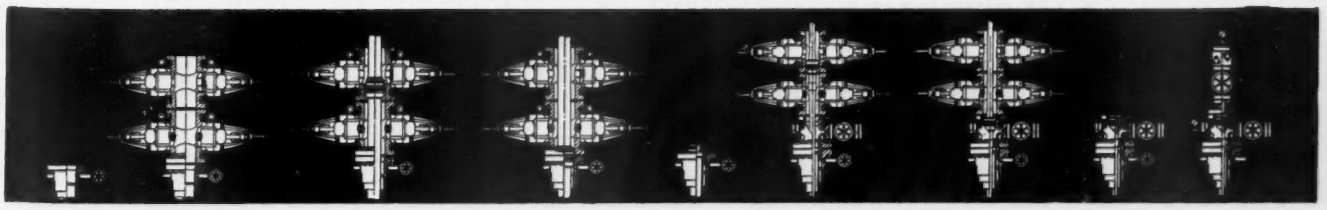


Casing Head Attached | Drilling | Running Casing | Casing Landed | Drilling Control Equipment Removed | Drilling-in and Running Tubing | Tubing Landed | Control Equipment Removed | Manifold Attached

Associations

NACE PRESIDENT Vance N. Jenkins, Union Oil Company of California, addresses the annual banquet of the National Association of Corrosion Engineers at St. Louis, during the Sixth Annual Conference. Others visible in the photograph are, left to right, F. J. McElhaaton, Panhandle Eastern Pipe Line Company, Kansas City; N. E. Berry, Servel, Inc., Evansville, Ind.; R. A. Brannon, Humble Pipe Line Company, Houston; A. A. Wachter, Shell Development Corporation, Emeryville, Calif.; O. E. Murrey, Midwestern Engine & Equipment Company, Tulsa; H. D. Murran, Cren-Ray Plastic Products Company, Midland, Texas; J. P. Casey, the Crane Company, Chicago; and F. L. LaQue, The International Nickel Company, Inc.

Interstate Group to Discuss Oil and Gas Conservation

Governor Fielding L. Wright of Mississippi will welcome the Interstate Oil Compact Commission at its spring quarterly meeting in Biloxi, Miss., May 4-6, Governor Roy J. Turner of Oklahoma, Commission chairman, announced.

Since the address of welcome is one of the principal addresses to be given before this meeting, Governor Wright will set out how conservation has benefited the public in Mississippi in keeping with the theme of the meeting—oil and gas conservation and the public interest.

The Legal Committee of the Compact Commission has as a project for this meeting a study of the conservation activities in the states during 1949, and will consider the form of oil and gas conservation statute which was presented to the Commission last summer.

The Secondary Recovery Advisory Committee will hear reports from committees which have been formed in several of the member states to study secondary recovery reserves within their respective states. The Stripper Well Committee will consider bringing up to date, as of January 1, 1950, its survey of stripper wells and reserves.

The proposed book of engineering principles will be presented by the Engineering Committee in final form.

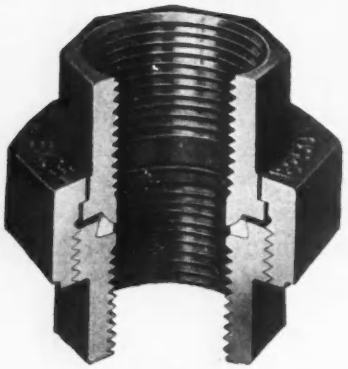
A study of pressure base upon which gas is reported in the various member states of the Compact will be presented by the Regulatory Practices Committee, and a study of well spacing and the controlling factors will be reported by the Research and Coordinating Committee by state.

Todd Is Kansas AAODC Leader

C. H. Todd, Rine Drilling Company, Wichita, Kansas, is the new Kansas Chapter chairman of American Association of Oilwell Drilling Contractors, succeeding H. Beardmore, Jr.

Other new chapter officers are E. L. McCartney, B & R Drilling Company, vice chairman for the Wichita area; James G. Adkins, Adkins Drilling Company, vice chairman for Central Kansas; and B. W. Burks, Derby Drilling Company, secretary.

Jefferson Malleable Unions



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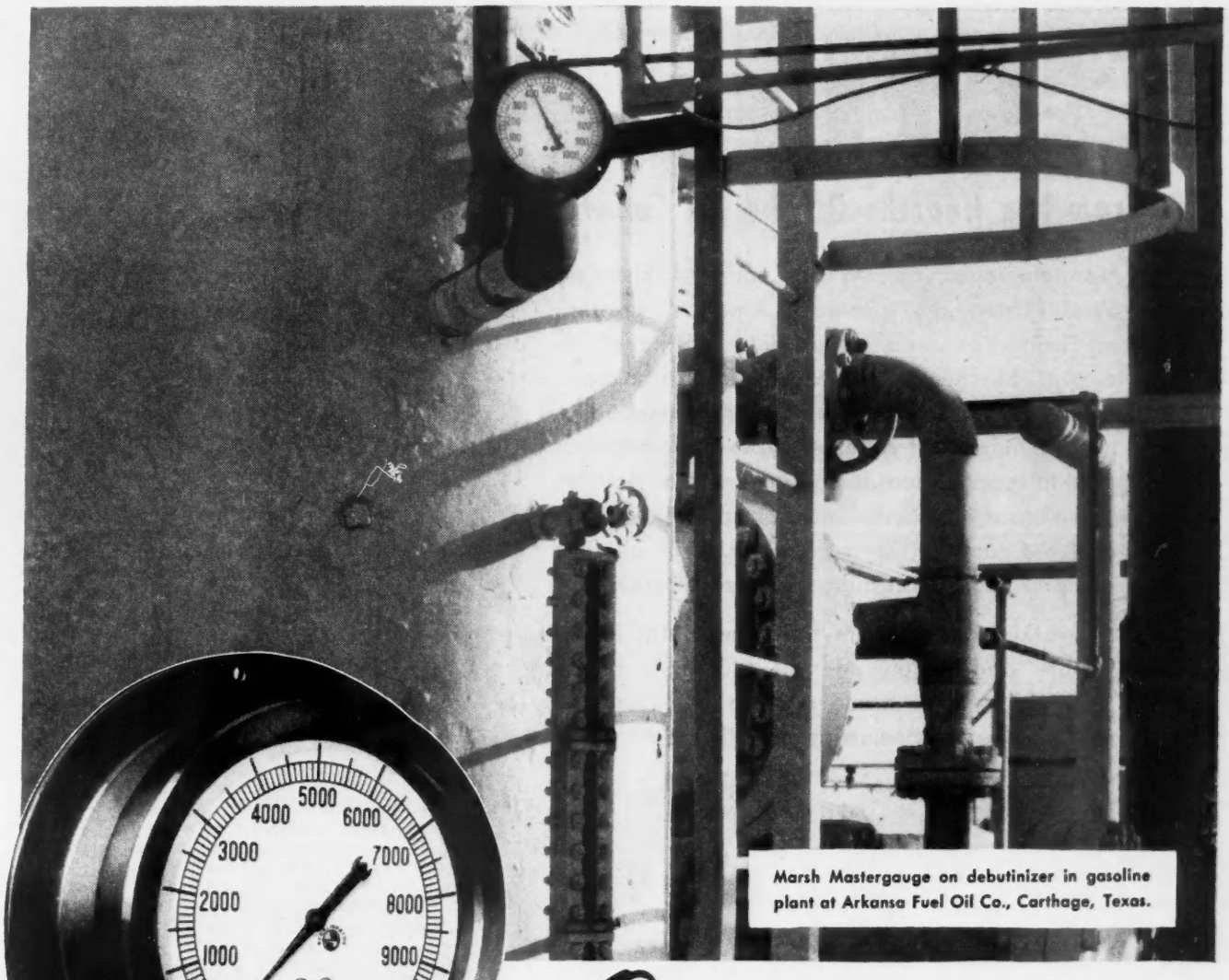

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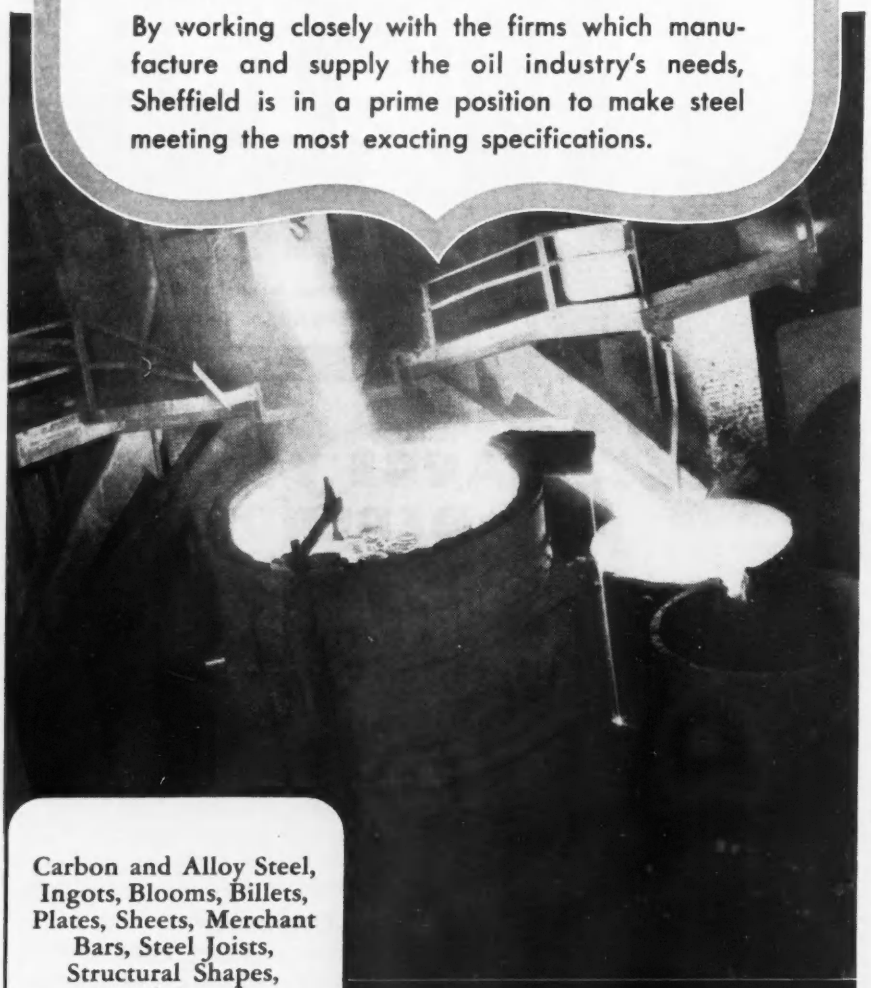

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NEW OFFICERS of the Kansas Chapter of AAODC are, left to right, J. G. Adkins, Adkins Drilling Company, Great Bend, vice chairman for Central Kansas; E. L. McCartney, B & R Drilling Company, Inc., vice chairman for Wichita area; B. W. Burks, Derby Drilling Company, secretary; and C. H. Todd, Rine Drilling Company, chairman.

Frank M. Porter Is Named Tenth President of API

Frank M. Porter of Oklahoma City on April 3 became the tenth president of the American Petroleum Institute, succeeding William R. Boyd, Jr. of Teague, Texas, who retired November 9, 1949, after holding the post nine years. Porter, 58, a native of Brooklyn, N. Y., is president and owner of the Fain-Porter Drilling Company of Oklahoma City, and has served as president of the Mid-Continent Oil & Gas Association for the past four years.

Frank M. Porter

Baird H. Markham was named to membership on the board of directors, and appreciation was expressed for his service as acting president of the Institute during the interim between Boyd's retirement and the selection of a permanent successor. Markham will continue to serve as director of the American Petroleum Industries Committee, a post he has held for 17 years.

Porter indicated that he will assume the duties of his office at once and spend the majority of his time in New York at API headquarters. He will continue to maintain his residence in Oklahoma City, however, and will continue as head of the Fain-Porter Drilling Company. He will resign the presidency of the Mid-Continent Oil & Gas Association in due course, he said.

Porter's career in the oil business began in 1916, when he started as a warehouse employee for the Dundee Petroleum Company in Ardmore, Okla. In 1918, he became associated with Wirt Franklin, poineer independent producer, and became vice president in charge of production of the Wirt Franklin Petroleum Corporation in 1927, which post he held until 1940. In 1939, he formed, with Leslie Fain of Oklahoma City, the Fain-Porter Drilling Company.

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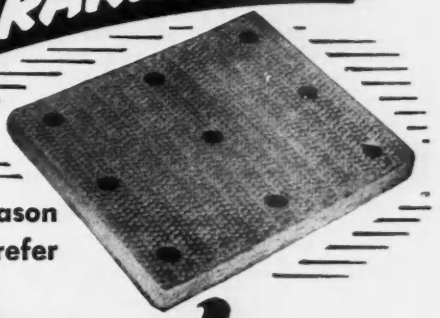

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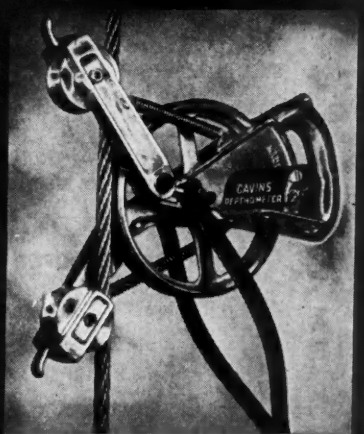
No more "Stringing-in" Guess Work



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New officers of the Mid-Continent API Division of Production are, left to right, Harold Spiller, vice chairman for southwestern Oklahoma; Glenn M. Stearns, district chairman; J. H. Field, chairman of the advisory committee; and Harold Berg, vice chairman for northeastern Oklahoma.

Stearns Elected Chairman Of Mid-Continent API Group

Glenn M. Stearns, The British-American Oil Producing Company, Tulsa, is the new chairman of the Mid-Continent District, Division of Production, API. He was chosen to succeed J. H. Field, Sohio Petroleum Company, at the spring sessions in Oklahoma City at which about 700 were in attendance. Other officers chosen include: W. D. Maxwell, The Carter Oil Company, Great Bend, Kansas, vice chairman for Kansas; Harold Berg, Tide Water Associated Oil Company, Tulsa, vice chairman for northeastern Oklahoma; Ralph O'Neill, Phillips Petroleum Company, Borger, Texas, vice chairman for The Texas Panhandle; Harold Spiller, The Carter Oil Company, Seminole, Okla., vice chairman for southwestern Oklahoma; and Fred Nealage, West Pampa Repressuring Association, Pampa, Texas, secretary-treasurer. Retiring Chairman Field was named chairman of the Advisory Committee.

It was announced that the API executive committee has completed its reorganization of the production division on a district level so that API chapters will function more efficiently. Henceforth drilling and production groups will function independently. The production practices committee will handle secondary recovery, well logging, core analysis, corrosion, artificial lift on deep wells, and infield drilling problems. The drilling practices committee will continue its studies of drilling fluids, testing of cements and equipment, and studies of crooked holes. On the "chapter level," subjects of the committees will be handled through study groups and forums. The study groups may also take up local or specific problems encountered in their areas, thus enlarging the scope of activities.

The general session at which Dean A. McGee, executive vice president, Kerr-McGee Oil Industries, Inc., and Field, presided, featured addresses by Frank Porter, president, Mid-Continent Oil and Gas Association, and Walace Hawkins, vice president and general counsel, Magnolia Petroleum Company, Dallas. Porter's topic was "Petroleum Has Served the Public Well," and Hawkins spoke on "Cooperative Oil and Gas Operations."

Rocky Mountain API Group Elects C. L. Larson Chairman

C. L. Larson, Jr., Stanolind Oil and Gas Company, Casper, Wyo., was elected chairman of the Rocky Mountain district, American Petroleum Institute, Division of Production at the district meeting in Casper. He succeeded Z. K. Brinkerhoff, Jr. of the Brinkerhoff Drilling Company, Casper.

A. E. Campbell, Seaboard Oil Company, Casper, was chosen secretary-treasurer.

Vice chairmen elected were: Montana —Rex Davis of Carter Oil Company, Cutbank; Colorado—E. P. Tallant of Union Oil Company, Denver; Wyoming —C. H. Griffin of Phillips Petroleum, Casper, and D. T. Hoenshell of General Petroleum Corporation, Casper, vice chairman at large.

API Offices Moved

Need for additional space resulted in the Division of Production, API, moving its headquarters to 816 Rio Grande National Building, Dallas 2, Texas. The old address was 1205 Continental Building, Dallas.

Petroleum Personnel Research has moved into its new home at 504 Richmond, Houston 6. The firm publishes *Texas Petroleum Directory* owned and edited by R. V. Logan. The 1950 edition, covering about 269 Texas towns with more than 40,000 industry listings, will be published soon.

A load of S. M. Jones Sucker Rods being loaded out of the big United Supply stock at the Velma, Oklahoma store.

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United folks are good folks to know because they can take care of all your drilling and producing needs whether your order is for one "pony rod" or a big load of sucker rods like the one shown above. You get the best in supplies and service at United — no matter what you need or what time you need it. Get acquainted with the United Supply men in your area — they are good folks to know.

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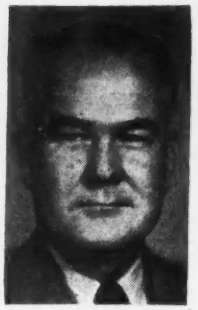
Pacific Coast API Announces Program for Annual Meeting

A thousand oil men are expected to attend the annual meeting of The API Pacific Coast Production Division in Los Angeles May 11 and 12, according to E. C. Babson, general chairman. Morning and afternoon sessions will be held at the Biltmore Hotel.

Speakers and topics for the drilling sessions, as announced by Chairman J. O. Hills, include "Historical Aspects of Blowouts," by Bert Stone, consultant; "Use of Tubing as Drill Pipe," by W. F. Bates, Shell Oil Company; "Well Blowouts in California—Causes and Prevention," by A. J. Horn, Standard Oil Company; and "Some Factors Influencing the Economics of Contract Drilling in California," by R. A. Powell, Santa Fe Drilling Company.

Chairman Paul Andrews of the production sessions, announced the following program: "The Application of Modern Clay Concepts to Oil Field Development and Exploitation," by R. V. Hughes, Stanford Research Institute; "Wilmington Field Shear Damage," by Jan Law, consultant; "Relative Permeability of California Oil Sands," by John I. Gates and W. Tempelaar Lietz, Shell Oil Company; and "History of Kettleman Hills Gas Injection Project," by D. R. Knowlton, Kettleman North Dome Association, and R. W. Masters, Standard Oil Company of California.



Fred C. Ripley

Lee J. Laird

Regents Choose F. C. Ripley Chairman of Nomads Board

Regents of the five Nomads chapters have chosen Fred C. Ripley, Jr., International Derrick & Equipment Company, Torrance, Calif., and Lee J. Laird, Gil-Lair Products, Inc., Pasadena, Calif., as chairman and secretary-treasurer, respectively, of the board of regents.

Ripley is one of the founders of the society, being a charter member of the Los Angeles group, which started as a local organization in 1938. He was national secretary-treasurer last year.

Laird has been a member since 1944, and last year was president of the Los Angeles Chapter.

IPAA Chooses New Directors, Names Planning Committeemen

J. D. Sanford, Rock Hill Oil Company, and Millard G. Sinclair, independent operator, both of San Antonio; Harold Decker, Houston Oil Company, Houston; and T. F. Grisham, Grisham-Hunter Corporation, Abilene, Texas, have been elected directors of the Independent Petroleum Association of America. Other new directors are Harold L. Woods, Monroe, La.; F. H. Harrell and W. O. White, Shreveport; C. E. Skiles, Mt. Carmel, Ill.; Russell P. Johnson, Olney, Ill.; and George E. Brimmer, Cheyenne, Wyo.

C. A. Johnson, IPAA vice president for Southern California, and Lawrence Vander Leck, Altadena, Calif., a member of the executive committee, are co-chairmen of a committee on general arrangements for the 1950 mid-year directors' meeting of the association, May 7-9 in Los Angeles.

More than 500 directors and members are expected to attend the meeting. Standing committees will meet Sunday, May 7, with general sessions scheduled Monday and Tuesday.

Stripper Well Meet Set May 8

Technical studies of the nation's stripper well oil reserves and secondary recovery methods will be reviewed by the National Stripper Well Association in Los Angeles May 8. The meeting will be held in conjunction with the IPAA mid-year meeting May 7-9 in the Biltmore Hotel.

A report will be submitted by the association's secondary recovery and stripper well survey committee headed by R. C. Earlougher, Tulsa petroleum engineer.

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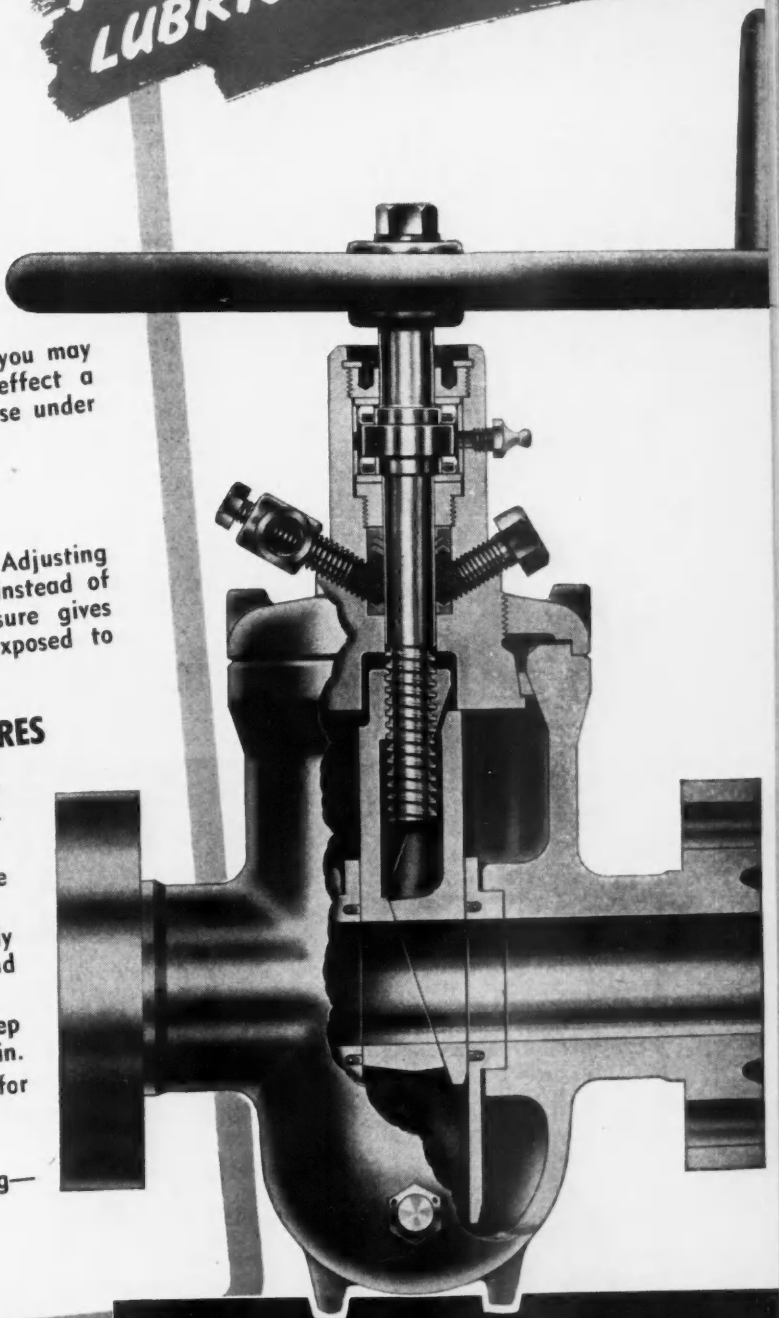
The design of the W-K-M Valve permits a method of lubrication not possible in any other valve. Both the body and bonnet serve as a grease reservoir, containing a surprisingly large amount of grease. The 3" valve, for example, holds 6 lbs., **enough to last indefinitely,** eliminating the necessity for frequent lubrication.

Every moving part of the valve is constantly in a bath of lubricant. The gate is submerged in grease at each operation, which contributes to the remarkable ease of opening or closing. However, **W-K-M Valves do not depend on grease to make a perfect seal.** Such complete lubrication prevents internal corrosion and reduces friction to a minimum, both of which so often cause valves to leak.

This is another of the several reasons why you may be sure that a W-K-M Valve will always effect a complete shut-off . . . will always open or close under full rated pressure.



PRESSURE SEAL BONNET

Requires no flanges—no studs and nuts. Self-Adjusting to pressure and temperature changes . . . instead of tending to push bonnet off, greater pressure gives tighter seal . . . considerably less area exposed to internal pressure.

PLUS THESE OTHER PROVED FEATURES

- Parallel expanding gates—seal directly across both seats with no distortion whatever—positive shut off both sides.
- Through-conduit openings—no turbulence —no restriction of flow.
- Oversize bronze renewable seats fully protected from flow in both open and closed positions.
- Combination wipe and seal rings keep gate clean . . . pressure out . . . grease in.
- Double roller thrust bearings on stem for ease of operation.
- Chrome Plated Gates.
- Combination plastic-chevron packing—uses no gland or gland follower.

THIS IS THE NEW - IMPROVED W-K-M FLOW-LINE AND CHRISTMAS TREE VALVE

W-K-M Company

OIL FIELD, PIPE LINE & INDUSTRIAL EQUIPMENT

HOUSTON, TEXAS, U. S. A.
LOS ANGELES

Cable Address: "WILKOMAC"
Export Office: 30 Rockefeller Plaza, New York, N. Y.

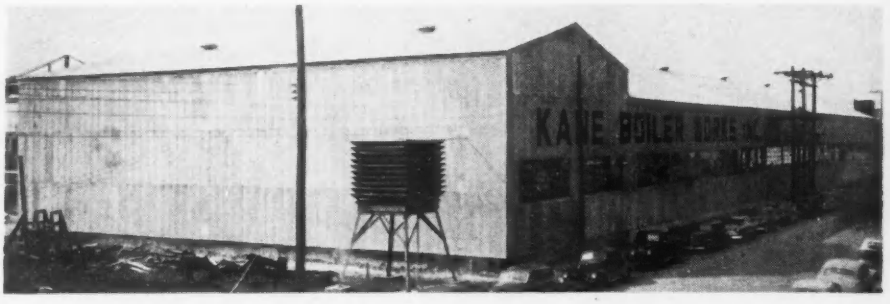
EQUIPMENT AND SERVICE SUPPLIERS' NOTES

Kane Boiler Works Galveston Plant Will Make Large Diameter Pipe

The first large diameter welded steel pipe mill operation on a production line basis in the Gulf Coast area has begun production on a limited scale. Joseph J. Kane, president of Kane Boiler Works, Inc., Galveston, said the new installation will produce big inch line pipe, with production capacity exceeding 10,000 tons per month when full capacity turnout is under way.

The expanded pipe mill is designed to manufacture welded steel pipe in sizes from 12¾-inch outside diameter to 36-inch o.d., in 40-foot lengths.

The company's new big-scale operation is the result of the need for big-inch line pipe production near point of consumption, thereby eliminating long, costly hauls from distant mills, according to Kane. "The design and machinery for the new mill is the result of 31 years continuous experience in the making of welded steel pipe," he explained.



Large diameter welded steel pipe is now being manufactured on a production line basis at this new Galveston pipe mill of Kane Boiler Works, Inc.

Dillon Company President Buys Interest in Climax Division

S. V. Dillon, president, Dillon Company, Tulsa, has repurchased his company stock from the Climax division of General Finance Corporation.

Dillon sold his interests to Climax during the war and the company manufactured the Dillon coupling under the name of the Climax Lock Coupling. This equipment is a grooved-type coupling with a two-part housing bolted together with a synthetic multiseal gasket insert that fits over the ends of the pipe and permits normal expansion and angular deflection of the line. The Dillon coupling is designed to compensate for stress and expansion of the line and provides great flexibility without leakage. It has especial application for pipe lines in earthquake zones and in areas where wide temperature ranges cause expansion and contraction of the line.

Rockwell Names Midwest Engineer And Tulsa Gas Sales Supervisor

Rockwell Manufacturing Company has appointed John L. Leisenring sales engineer for the southern two-thirds of Indiana and several counties in the southern part of Illinois.

John L. Leisenring

Orville W. Barnett

Leisenring joined the company in 1945 after his discharge from the Army, as a service engineer in the Chicago district, handling the field maintenance of all products. For the past year and a half he has been assigned to industrial accounts in the Chicago area. In his new assignment he will handle the company's line of valves, gas meters and regulators.

The company has named Orville W. Barnett as gas products sales supervisor in the Tulsa district. Barnett, who joined the company in 1934, will continue to headquarter in Dallas.

George Dwyer Appointed

J. P. Magoffin, general sales manager of the Patterson-Ballagh Division, Byron Jackson Company, and B. A. Hilliard, Jr., general sales manager of the Oil Tool Division, announced appointment of George Dwyer as joint sales representative with headquarters at Casper, Wyo.

Dwyer joined BJ in 1941 and entered the army in 1942. Upon his discharge he rejoined BJ in the Export department, transferring to sales work in 1948.

Where Oil and Gas Men
STOP and GO in Oklahoma City
And for a fun-packed weekend - Make it a point to spend "A Weekend at the Skirvin" at our new package rate.
Your weekend includes . . .
A modern, comfortable Skirvin room (from Saturday noon until 5 P. M. Sunday).
Saturday Evening at the fashionable new Persian Room which includes . . . Dinner, Beverages and Dancing to the music of a leading hotel orchestra.
Breakfast in bed Sunday morning, or in the Coffee Shop if you prefer.
Free adjacent parking.
All for a "package rate" of $16.00 for two, or $9.00 for one.
When making reservations, please specify "Weekend at the Skirvin."
DAN W. JAMES PRESIDENT
the Skirvin OKLAHOMA CITY

A Two-Day Sales Meeting in Tulsa brought together resident managers, production representatives and Tulsa personnel of the Bethlehem Supply Company. Pictured are, from left to right, first row, Fred Parks, J. C. Knoll, C. E. Medley, H. R. Klein, M. R. Griffith, E. S. Lewis, H. A. Wilson, P. H. Jezzard, Jr., R. A. Johnson, J. V. Spalding, W. T. Davis. Second row: W. E. Stevenson, J. F. Eaton, F. R. House, V. W. Bailey, C. C. Crider, G. A. Thompson, C. R. Zimmerman, I. C. Smith, H. R. Powers, J. T. McKenna, N. G. Blankenship, W. J. Brady, R. E. Dow. Third row, standing: H. E. Davidson, R. F. Arbs, F. S. Rudrow, N. D. Lee, J. G. Floyd, D. G. Rhoads, J. K. Davis, H. S. Sutton, T. C. Graham, F. C. Batson, D. H. Geary, H. V. Harder, R. E. Carlington, Jr., Arthur Weber, Jr., C. R. McNair, Jr., G. L. Reid, Guy Brown, Jr., W. A. LaRew, R. L. Neal. Top row: J. L. Nelson, H. A. Barnes, A. T. Padavic, G. B. Sager, C. W. Henry, D. C. Thomas, R. A. Day, Joe Chastain, O. H. Crowe, T. B. Simpson, R. W. Neal, Christian Seger, Jr., L. A. Myers, and T. W. Thurmond, Jr. H. L. Hawkinson, Jr., Houston, and W. F. Taylor, Tulsa, are not pictured.

Bilbey in Charge of McCullough Fishing Tool Service in Canada

Charles Bilbey is now in charge of fishing tool service for McCullough Tool Company's Canadian branch in Edmonton. Bilbey has been actively engaged in fishing tool service for more than 15 years. More than 13 of these years were with drilling contractors and two with McCullough Tool Company at Bakersfield, Calif.

Charles Bilbey

"Bilbey's long experience and thorough knowledge of fishing problems and how to solve them has proven to be an invaluable asset to our customers in Canada," stated I. J. McCullough, president.

Eastman Chooses Vice President, Names Gulf Coast Division Manager

William G. James, formerly Gulf Coast division manager for the Eastman Oil Well Survey Company, Houston, has been named vice president in charge of sales, and has moved to the general office in Denver, where he will direct the company Sales division in the Rocky Mountain-Mid-Continent, Gulf Coast and California areas. James has been with Eastman 17 years.

Replacing James as division manager in Houston is William D. Compton, formerly general field engineer at Denver. Compton has been with the company since 1943, when he started as an assistant junior engineer.

Core Lab Distributes OB Mud Guns

Core Laboratories, Inc., Dallas, has been appointed exclusive distributor for OB mud guns domestically east of California and in Canada. Manufactured by Oil Base, Inc., Compton, Calif., the guns are available in three models, for top-hole and bottom-hole mixing. Distribution in California will be handled by Oil Base, Inc.

Mud Products, Inc., Tulsa, distributes OB mud guns as standard equipment on welded steel suction pits in the Mid-Continent and Gulf Coast areas.

FOR YOUR 7 TO 13 H.P. POWER JOBS

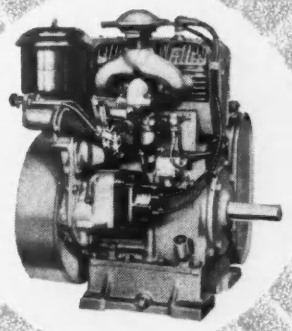
Two-Cylinder

WISCONSIN

Heavy-Duty

Air-Cooled

ENGINES



Models TE and TF standard engine illustrated; also available as complete Power Units with Clutch Take-Off Assembly or with Clutch Reduction Assembly.

Designed and built to traditional Wisconsin Motor heavy-duty service standards, this pair of Air-Cooled 2-cylinder engines provide ideal power either as component units on original equipment, or as stationary or portable general purpose power within the 7 to 13 hp. bracket.

The Model TE delivers from 7.2 to 11.2 hp. and the Model TF turns up 8.6 to 13.3 hp. within a 1400 R.P.M. to 2600 R.P.M. speed range. Features include: tapered roller bearings at BOTH ends of the heat-treated, drop-forged crankshaft; high tension rotary-type OUTSIDE Magneto with impulse coupling; oil bath air cleaner; ¾" standard float feed carburetor; positive lubrication by Pump with individual oil stream to each rod . . . *plus* dependable air-cooling at all temperatures from sub-zero to 140° F.

For "Most H.P. Hours" of on-the-job power service, specify Wisconsin Air-Cooled Engines . . . single cylinder, 2-cylinder and 4-cylinder, in a complete power range from 3 to 30 hp.

WISCONSIN MOTOR
Corporation
MILWAUKEE 14, WISCONSIN
World's Largest Builders of Heavy-Duty Air-Cooled Engines

WRITE TO HARLEY SALES CO.
510 ATLAS BUILDING, TULSA, OKLAHOMA
M & M BUILDING, HOUSTON, TEXAS
505 SOUTH MAIN ST., WICHITA, KANSAS
OIL FIELD DISTRIBUTORS FOR WISCONSIN ENGINES AND ALL TYPES OF UTILITY UNITS.

Eight Directors Elected by Seismograph Service Firm

G. H. Westby, president, and seven others were elected to the board of directors of Seismograph Service Corporation. Other board members are Dr. A. J. Barthelmes, A. B. Chappell, Dr. J. E. Hawkins, H. M. Thralls, Ralph W. Davis, Faulkner C. Broach and L. D. Simmons. All but the latter three are employed by the firm.

Dr. Barthelmes has been placed in charge of the company's worldwide exploration activities and its subsidiaries as vice president in charge of exploration; Thralls has taken over direction of SCC's seismic explorations in the U. S. as vice president in charge of domestic exploration; and Dr. Hawkins has been given the additional management of manufacture and supply in his position as vice president in charge of research, manufacture and supply.

J. L. Hull, Jr., was reelected secretary and named general counsel for the company.

Safety Plaques were awarded by John G. Staudt, executive vice president and general manager of Dowell Incorporated, to managers of four Dowell districts. Left to right are Staudt, W. S. Day of Mt. Pleasant, Mich.; Jack Sutherlin of Wichita Falls, Texas; Jim A. Cummin of Wichita, Kansas; and Charles L. Power, Jr., of New Orleans.

Somervell Becomes Chairman of Koppers Board of Directors

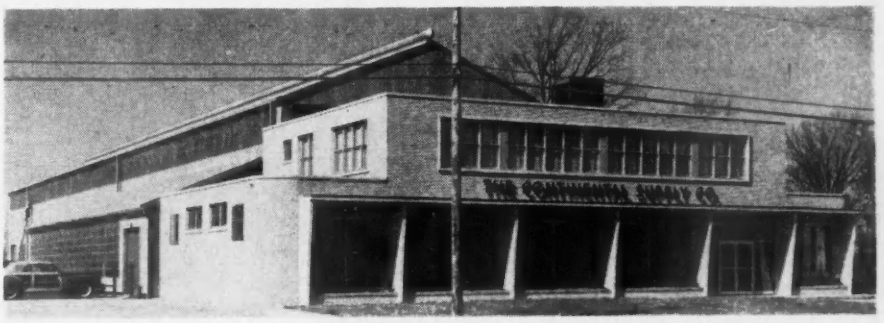
General Brehon Somervell, president of Koppers Company, Inc., since May, 1946, has also been named chairman of the company's board of directors. His election followed the retirement of J. P. Williams, Jr., as company chairman. Williams was elected to the presidency of Koppers Company and as executive vice president of Koppers United Company in 1939. From 1944 to April, 1946, when General Somervell became president, he served as president and chairman of the board of the present company. W. F. Munnikhuysen, who has been vice president and general manager of the company's Wood Preserving Division, was made executive vice president of the company. He was also named to the board of directors along with Joseph Becker, vice president and general manager of the company's Engineering and Construction Division.

CLEVELANDS
THE BEST INVESTMENT
For Oil + Gas Trenching

CLEVELAND TRENCHER in the suburbs of an Illinois city, cutting trench for 16 miles of 20" to 24" line.

When you invest in CLEVELAND TRENCHERS for all your trench excavation work you draw extra dividends in the form of steady, dependable schedule-beating performance and a faster pace for your pipe crews. CLEVELANDS extra power, wide range of transmission-controlled speed combinations, and tough all-welded construction make short work of the worst digging conditions, while CLEVELAND "unit" assemblies allow necessary repairs to be made quickly and easily in the field. CLEVELANDS correct wheel-type design gives you cleaner and better trench, plus the superior flexibility that permits cutting on or off the line without leaving "plugs". You need CLEVELAND "dividends" on your main, transmission, distribution, service and gathering line work. See your local distributor for the full story.

THE CLEVELAND TRENCHER CO.
20100 ST. CLAIR AVENUE • CLEVELAND 17, OHIO



The New District Office, store and warehouse building of The Continental Supply Company in Shreveport was opened with a barbecue dinner to which 1250 guests were invited. The air conditioned office building at 1325 North Market Street is of concrete and brick, and is completely fire-proof. The warehouse is a structural steel building and is equipped with a 25-ton overhead crane capable of handling the largest equipment in the oil country. E. N. Wood is Continental's district manager at Shreveport.

Harris Is Cameron Sales Manager; Bliss Is "LP" Valve Engineer

Cameron Iron Works, Houston, has appointed Jack Harris manager of the company's new "LP" Valve division. A

Jack Harris

Ames Bliss

1935 graduate of Rice Institute, Harris has served as development engineer on the new Lift-Plug valve and other new equipment. Before joining Cameron, he was with the J. S. Abercrombie-Harrison Oil Company refinery at Sweeney, Texas.

Ames Bliss has been named sales engineer for the "LP" Valve division. A graduate of the Massachusetts Institute of Technology, he was a member of the Cameron engineering staff.

Robert H. Morse, Jr., Elected President of Fairbanks, Morse

The third generation Morse became president of Fairbanks, Morse & Company, on March 22.

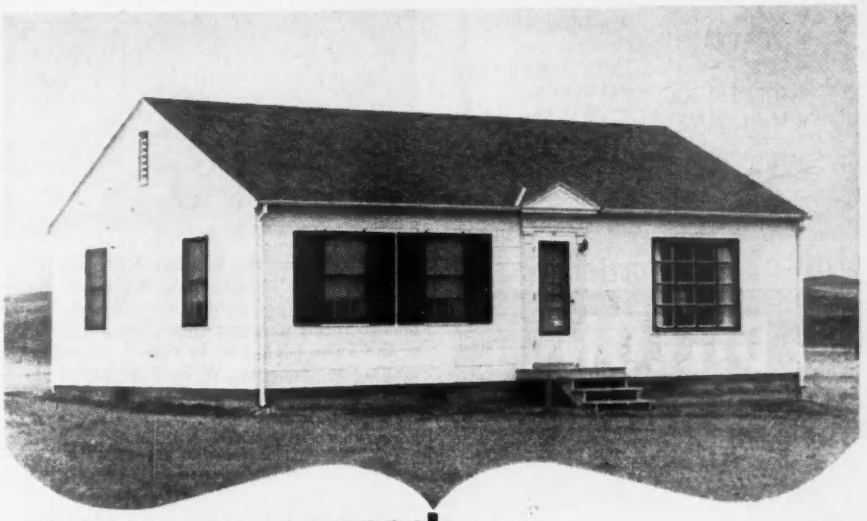
Robert H. Morse, Jr., who started with the company in 1916 in the foundry of the Beloit, Wis., plant, was elected to the presidency by the directors, following the annual meeting of stockholders.

Robert H. Morse, Jr.

He has been vice president in charge of operations. Previously, he was vice president in charge of sales, assistant general sales manager, and has held many other positions.

His father, Colonel Robert H. Morse, whom he succeeded, becomes chairman of the board. Colonel Morse has been president since 1931 and has spent 55 years with the company. He also started in the Beloit Plant.

His grandfather, Charles Hosmer Morse, was the founder of the company and was chairman of the board upon his death in 1921.



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Order today and get quick delivery of the STURDYBILT houses you need. Homes, warehouses, tool houses or any other buildings can be delivered and erected in record time. Write today for information.

PREFABRICATED 30 Years HOME MANUFACTURER

MANUFACTURERS OF SPECIAL MILLWORK; DISTRIBUTORS OF JOHNS-MANVILLE BUILDING MATERIALS; CURTIS WOODWORK

STURDYBILT

SOUTHERN MILL & MANUFACTURING CO.

Tulsa, Oklahoma

Prefabricated, Demountable Houses

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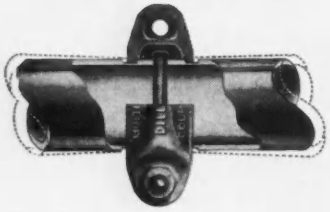
STURDYBILT HOUSES COMPLY WITH COMMERCIAL STANDARD CS 125-45 OF THE NATIONAL BUREAU OF STANDARDS FOR PREFABRICATED HOMES

DILLON
flexible-locked
COUPLINGS



POSITIVE SEAL FOR

- OIL
- GAS
- WATER
- AIR
- PRESSURE
- VACUUM

Available for Dealers and Sales Representatives.

A grooved-type coupling with a two-part self-aligning housing. Synthetic Multi-seal gasket gives great flexibility without leakage-pressure or vacuum. Available in sizes from 2" to 20".

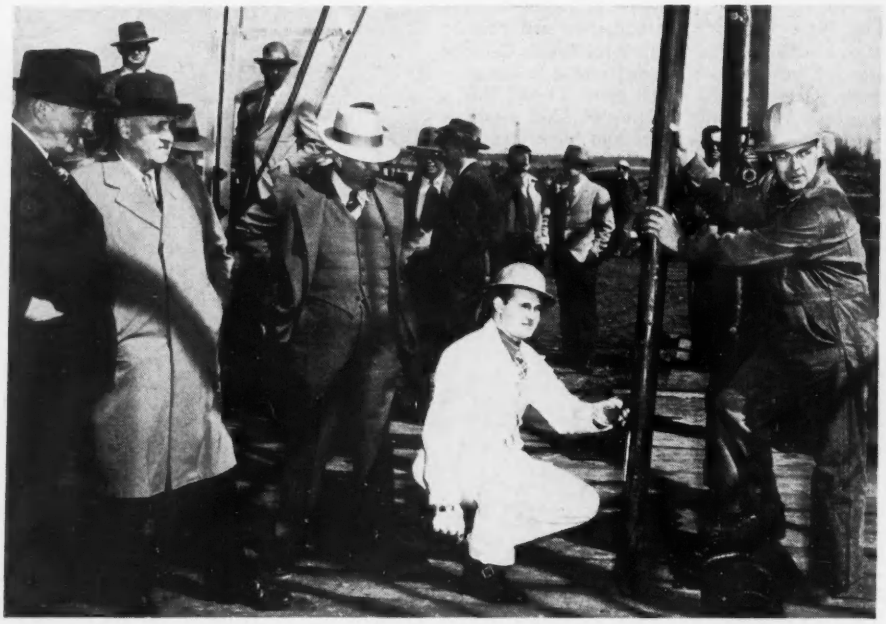
Hold that line with Dillon Couplings

THE DILLON CO.
TULSA 5, OKLAHOMA

PETROLEUM ENGINEERS
CABLE & STINE
WICHITA FALLS, TEXAS

EXPERIENCED PRACTICAL AND TECHNICAL CONSULTING PRODUCTION ENGINEERING SERVICE

SPECIALIZING in MODERN SECONDARY RECOVERY



Preparing to run the 25,000th Lane-Wells radioactivity well log survey at the old Mary Sudik 1, Cities Service Oil Company's well which opened up the prolific Wilcox sand zone in the Oklahoma City oil pool. The run was made March 24 and was witnessed by scores of oil company executives and operators who participated in a special celebration climaxed by a cocktail party and reception at the Tulsa Club. Left to right are Rodney Durkee, president, Lane-Wells Company; M. V. Kirvin, production manager; Wylie Pitchford, farm boss, Cities Service Oil Company; R. L. Gregg, Jr., radioactivity operator; and F. S. Bertram, hoist operator, Lane-Wells.

25,000th Radioactivity Well Log Is Run by Lane-Wells Company

The 25,000th radioactivity well log was run by the Lane-Wells Company March 24 on the Mary Sudik 1 well which discovered the Wilcox sand in the Oklahoma City field. The well was 20 years old March 26. Cities Service Oil Company, operator of the Sudik well, ran the test to explore the possibilities of obtaining oil or gas production in any upper zone now behind the casing. The Wilcox sand zone in the field had produced nearly 500 million barrels up to January 1. The Wilcox zone is still producing about 12,500 barrels a day from 420 wells.

Sudik 1 flowed its production until January, 1936, when it was placed on pump. After pumping a short time the well was shut down until November, 1938, when it was utilized in the secondary recovery program in the south part of the Oklahoma City field. The well has produced nearly 800,000 barrels of oil.

The occasion indicated the steady growth in the popularity and acceptance of the radioactivity well logging service since it was introduced commercially in April, 1940, in the Polo field in northern Oklahoma. It is noteworthy that 15,000 radioactivity well logs have been run since October 24, 1947, when the 10,000th log was run.

The need for a method of obtaining more well information through casing spurred the development of radioactivity well logging, which was conceived in 1938 by Engineering Laboratories, Inc.

The knowledge that gamma ray radiation from rock formations could be converted into small electrical currents led to intense research and development to solve the problems of creating instruments to measure these currents. These currents, which measure about one ten-trillionth of an ampere, are utilized in a technique that provides the oil operator with a continuous graphic curve which reveals subsurface rock formations in either open or cased holes. The curve so developed is known as the Gamma Ray curve.

The first commercial job in April, 1940, was done by Well Surveys, Inc., a separate concern set up by Engineering Laboratories, Inc. In June, 1940, Lane-Wells was licensed to offer the service throughout the U. S. and Canada. Through subsidiary organizations the service is now available in Canada and Venezuela.

The neutron curve, introduced in 1941 to provide additional information, has been accepted as a vital part of logging technique.

The neutron curve is by itself an indirect indicator of relative porosities. A new analytical technique currently under development by Lane-Wells and W. S. I. makes it possible to interpret the neutron curve in terms of actual porosity. Porosity determinations made by this method from curves taken in open and cased holes agree almost exactly with porosities of formation cores determined in the laboratory.

These two curves are used in a variety of applications such as obtaining a complete record of the formations where mechanical difficulties and contaminated drilling muds prevent other types of logging.

The feature which makes the curves so useful in measurement problems is the collar log. The gamma ray curve with the imposed collar log provides a permanent record of the fixed relationship of casing collars to formations which is extremely heplful in planning any well operation anywhere in the well at any time in the future.

an International U-9 power unit

PUMPS 15 PRODUCING WELLS

The power center of a Cedar Brakes, Texas, oil field pumping setup owned by the J. F. Baker Oil Co., is an International U-9 Power Unit. Twenty-four hours a day, this engine converts natural gas into well-pumping power through a flat gear box. Seventeen lines are hooked up to this gear box, fifteen on oil wells and two pulling counterweights. One line is alternately used for a water well supplying the pumper's house. The U-9 replaced a steam engine and, in 3600 hours of operation, proved to be more reliable and trouble-free, according to pumper Gail Mitchell.

For a dependable, efficient solution to your oil field power problem, see your International Distributor, Dealer or Oil Field Supply House. The full line of International diesel and gas-gasoline engines is designed to fill almost every oil field power need. Make International *your* power and get the benefits of dependable, low-cost operation.

Standardize on Power that Pays

INTERNATIONAL HARVESTER COMPANY • Chicago

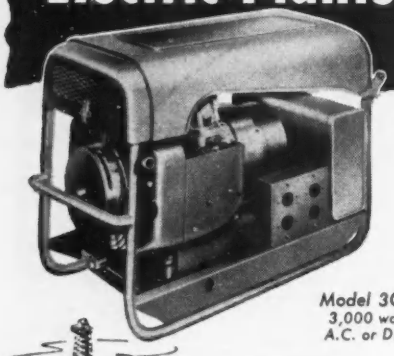
Tune in James Melton and "Harvest of Stars,"—NBC., Sunday afternoons

CRAWLER TRACTORS
WHEEL TRACTORS
DIESEL ENGINES
POWER UNITS

INTERNATIONAL HARVESTER

INTERNATIONAL INDUSTRIAL POWER

ONAN *Oilfield*
Electric Plants



Model 3CK
3,000 watts
A.C. or D.C.

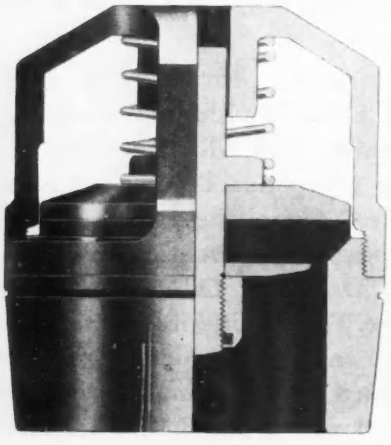
HEAVY-DUTY PORTABLE & STATIONARY MODELS
Diesel, Gas, Gasoline-powered

● ONAN oilfield electric plants provide dependable light and power for oil field applications. A complete range of A.C. and D.C. models... all conservatively rated for continuous, dependable service helps you choose the right plant for the job. Lightweight, air-cooled models from 400 to 5,000 watts; heavy-duty, water-cooled, gas-gasoline-driven plants from 3,000 to 75,000 watts. Air-cooled Diesel electric plants 2,500 and 5,000 watts. Water-cooled Diesels from 12,500 to 75,000 watts, powered by IH engines.

Write for Literature

D. W. ONAN & SONS INC.
5356 Royalston Ave., Minneapolis 5, Minn.

L-K Tapered Cage Type Pump Valve. (Style No. 107)



These valves are in use handling Iso Butane, Normal Butane, Pentane, Gasoline, Kerosene and Crude Oil.

These valves are especially good in reducing surges and in promoting smooth pump performance.

A modified type of our Reversible Tapered Cage Type Pump Valve. It is especially recommended for extremely high pressures, unusually severe shock conditions and exceptionally high speeds. Some of these valves are now in service up to 263 strokes per minute.

L-K
Pump Valve Co.
P. O. Box 901 Houston 1, Texas

EQUIPMENT and SERVICE SUPPLIERS' NOTES

Office of the Lufkin Machine Company, Ltd., in Edmonton, Alberta.

Lufkin Named Western Canada Representative for Gaso Pump

Gaso Pump & Burner Manufacturing Company, Tulsa, announced appointment of Lufkin Machine Company, Ltd., as its exclusive distributor in Western Canada. The offices and warehouse of Lufkin are located at 14321 108th Avenue, Edmonton, Alberta, where a complete stock of Gaso pumps and repair parts will be available for the oil industry in that area. The Edmonton office will be in charge of Charles E. Dyer.

Charles E. Dyer

Since 1933 Dyer has been associated with Lufkin's parent company, the Lufkin Foundry & Machine Company of Lufkin, Texas. During that time he acquired practical machine shop and sales experience before being appointed manager of Lufkin branches in Kansas and the tri-state area of Mississippi, Louisiana and Arkansas. During World War II he served in the Ordnance Department in New Guinea and the Philippines.

Gaso has been furnishing pumps for the oil industry in Canada for the past 16 years and now has more than 200 in service in that area. Repair parts for all of these pumps will be carried in stock by Lufkin Machine Company, Ltd., at Edmonton.

Oil Well Supply Promotes Durham

James A. Durham, storeman in the Charleston, W. Va., store of Oil Well Supply Company, has been promoted to store manager. He succeeds C. E. Lewis, who has transferred to Odessa, Texas, as a field representative.

Durham was formerly at the Parkersburg, W. Va., store. Lewis became store manager at Charleston in 1946, and before that was field salesman at Clarksburg, W. Va.

Plans for the erection of a warehouse and modification center in the Dallas area were also announced by Oil Well Supply Company.

Pacific Coast Official Named By Rockwell Manufacturing

Lee Snodgrass was named Pacific Coast supervisor of the Gasoline and Oil Meter Division of Rockwell Manufacturing Company. Snodgrass started in Rockwell's Valve Division in 1941 and for the past few years has been specializing in oil and gasoline meter sales. His present duties will involve supervision of all sales and service of the oil meters and accessories manufactured on the Pacific Coast by Rockwell. for the production, refinery and marketing divisions of the oil industry.

Lee Snodgrass

Two Schlumberger Men Transfer

R. C. Davis, Cody, Wyo., has been transferred to Hobbs, N. M., as manager of that district for Schlumberger Well Surveying Corporation. He replaces G. J. Decker, who has moved to Edmonton, Alberta, Canada, on a special assignment.

Construction Is Under Way on this one-story office for Rector Well Equipment Company, Inc., at N.E. 10th and Commerce streets, Fort Worth. The building is across the street from the company's plant, which was enlarged last year.

ONE Packer That Will Not "Cold Flow"

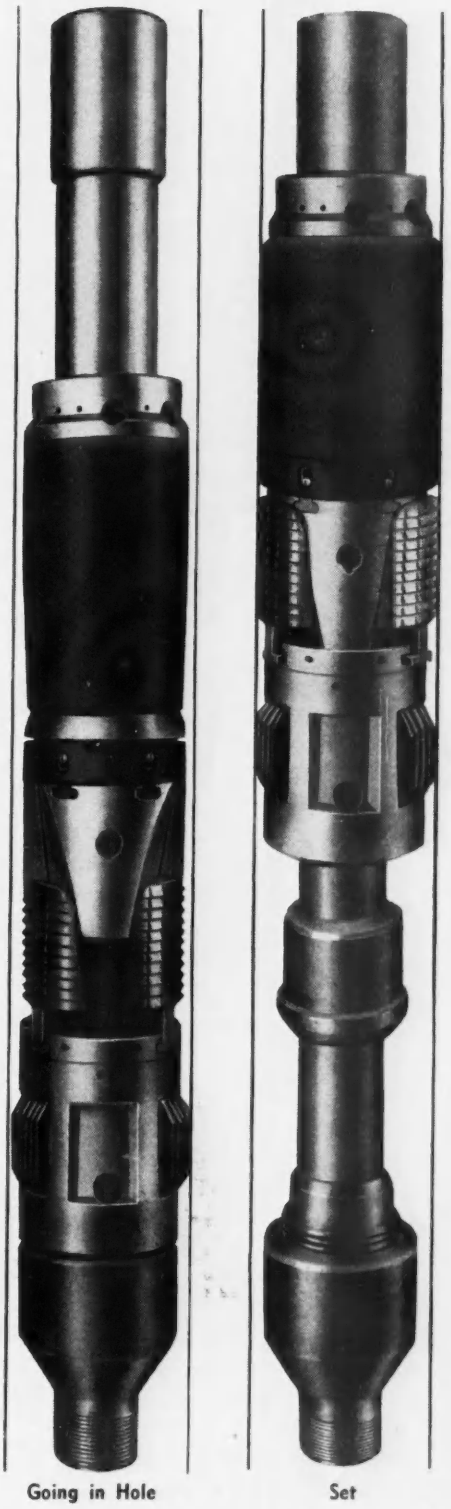
The WILSON Type "MB" "Metal Block" HOOK-WALL PACKER

This Packer was developed with the one purpose in mind . . . to give a perfect "Pack-off," regardless of the hydrostatic head.

In the Wilson Type "MB" Metal Block Packer, the packing element cannot "Cold Flow," no matter how deep you are or how heavy the mud. The "Metal Blocks" (shown in red in the illustrations) completely block the element when Packer is set.

To save time, money and trouble on the *deep ones* . . . run a Wilson "Metal Block" Packer *first* . . . and know the performance will be satisfactory.

If your supply store don't have this out-sanding Wilson Packer, write:



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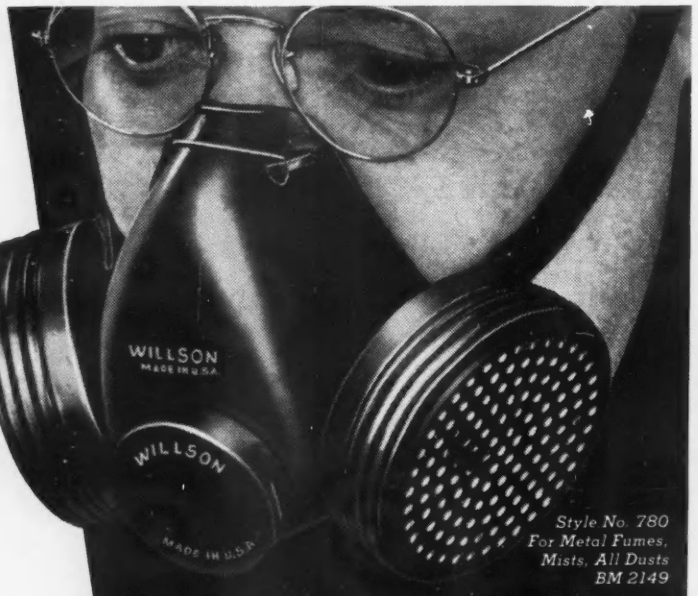

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For Metal Fumes,
Mists, All Dusts
BM 2149

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Protection With Comfort

Style No. 731
Chemical Cartridge
For Gases and Vapors
BM 2303

Style No. 45D
For All Dusts
BM 2152

Style No. 5D
For All Dusts
BM 2152

Style No. 750D
For Mists and All Dusts
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Dependable Products Since 1870
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Here is the most complete line of Bureau of Mines approved respiratory protective equipment. It includes filter and cartridge type respirators which are effective against all dusts, mists, fumes and low concentrations of acid gases and organic vapors. Ease of breathing and comfortable fit assure a low fatigue factor. Choose exactly what you need from selector tables in our new catalog. Get a copy from your nearest WILLSON distributor or write direct to WILLSON PRODUCTS, INC., 104 Thorn Street, Reading, Pa.

EQUIPMENT and SERVICE SUPPLIERS' NOTES

Air Shipment of an FWD truck weighing approximately 7000 pounds, from New York to Cairo, Egypt—a flight of more than 5000 miles—was accomplished by the Four Wheel Drive Auto Company. Left to right are Captain Milander, pilot of the plane which carried the truck; Wallace P. Neth, vice president of Seaboard and Western Air Lines; H. B. Hobson, FWD's New York Export Office manager and John MacDonald, export manager for the company, who supervised loading operations. The truck was partially disassembled for shipment, and was re-assembled and tested under the direction of Eldred Etheridge, FWD's near-eastern representative.

Tucker, Thompson Appointed By Perforating Guns Company

Frank L. Tucker has been named manager of service and operations and George E. Thompson has become sales manager for Perforating Guns Atlas Corporation, Houston.

Tucker has been with the company

Frank L. Tucker

George E. Thompson

since 1938. Previously, he was with Reed Roller Bit Company's Sales and Service departments for four years.

Perforating Guns provides field services from its executive offices in Houston and from 12 branch offices in the U. S. Service in Canada is provided from a Canadian affiliate's office.

Thompson joined Perforating Guns seven years ago. He has been associated with well-perforating companies since the inception of electric gun perforating in the Gulf Coast area. Promotion of the company's jet and bullet perforating services, as well as the sale of gamma ray logging and the recently announced atomic-neutron logging facilities, will be handled by Thompson. He will also be in charge of the sale of the firm's Baker wireline bridge-plug and packer services.

EQUIPMENT and SERVICE SUPPLIERS' NOTES

Texas-Southern Contracting Company Acquires Whitaker Pipe Line Firm

Texas-Southern Contracting Company has acquired the O. C. Whitaker Company and will continue in the pipe line

I. C. Little, Sr.

Robert Thomas

construction business with the same management, equipment and field organization. O. C. Whitaker Company was a charter member of the Pipe Line Contractors Association and had been active in the field of pipe line construction for many years.

It was first announced that the name of the new company was "Southern Contracting Company." The change to

J. C. Minyard

J. C. Briscoe

the name "Texas-Southern Contracting Company" was necessary because of a similarity in name to other corporations in various Southern states.

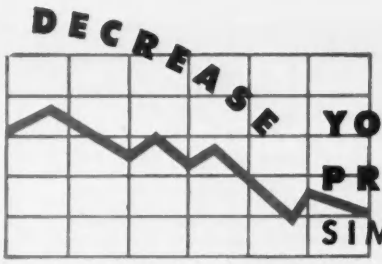
President of the new Texas-Southern Contracting Company is Robert Thomas, formerly associated with O. C. Whitaker Company. Thomas has taken part in many activities of the Pipe Line Contractors Association. I. C. Little, Sr., Dallas, is vice president, and J. C. Briscoe, also formerly with O. C. Whitaker Company of Fort Worth, is vice president and secretary-treasurer. J. C. Minyard is general superintendent.

First contract on which the new company started work is the construction of 92 miles of 30-inch line, designated as Section D, from the Sabine River to Porters, Texas, for Transcontinental Gas Pipe Line Corporation.

Texas-Southern Contracting Company will maintain its headquarters at 804 Dan Waggoner Building, Fort Worth.

Geophysical Office Established

Southern Geophysical Company has established a new division office at 216 North Big Spring Street in Midland, Texas, to serve West Texas and New Mexico. R. E. Davis and Elmer F. Blake are supervisors in charge of the office.



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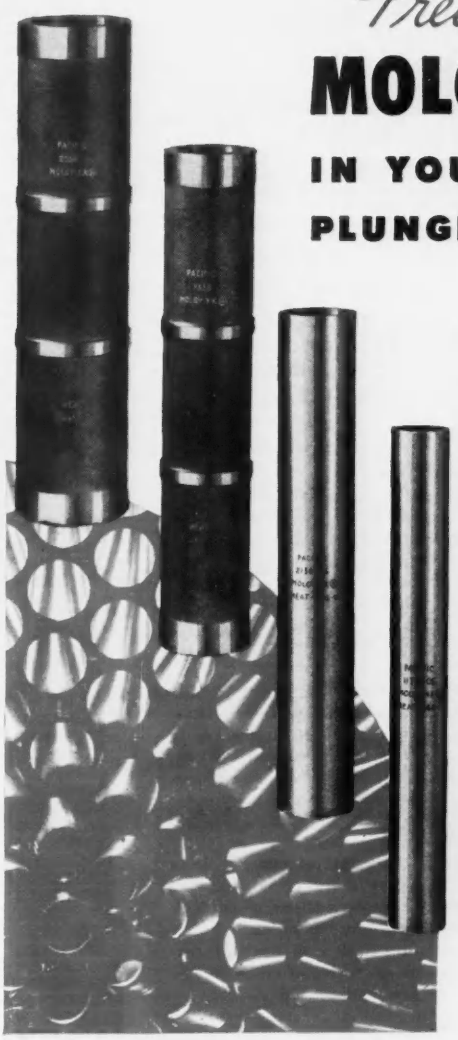

MOLOY—® a ferrous alloy developed by Pacific primarily for oil well plunger pump liners has all the qualities for long economical life in your well. Strength, toughness, hardness combined, give MOLOY greater resistance to temperature, corrosion and abrasion than ordinary iron liners.

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IN FIELD AFTER FIELD, THE STRENGTH AND DURABILITY OF MOLOY—® LINERS HAS REDUCED PRODUCTION COSTS AS MUCH AS 50%

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MAKES A VALVE FOR EVERY WELL CONDITION

Let your Camco engineer help you select the type valve best suited for your specific gas lift problem. Send for the new Camco catalog. Write CAMCO, INC., 7315 Canal Street, Houston, or CAMCO SERVICE, 1004 N. Texas Street, Odessa, Texas.

PRESSURE CONTROLLED VALVES—
CAMCO'S Bellows Pressure Monel Spring Operated Flow Valves are preferred by most users of surface-controlled gas lift because of their high lifting efficiency and adaptability to widely varying conditions. Sizes range from macaroni string valves to giant sluggers. They're recommended for either open or closed, single or dual installations, which may require selective intermittent, selective continuous or selective annulus flow.

DIFFERENTIAL FLOW VALVES—
Fluid pressure in the tubing causes these Camco valves to open and allow gas to enter and move the fluid column upward. Really useful in completed wells where maximum velocity is the key to efficient gas lifting. Removable orifice buttons permit selective control of gas volume used. Available with Camco "Ball" type reverse check valves and mandrels for tubing or annulus flow.

CONSTANT FLOW VALVES—
A new type valve that operates by the weight of tubing fluid in conjunction with annulus pressure. They're similar in design to Camco's pressure controlled valves, with the addition of an "O"-ring seal between the two chambers and free flowing choke orifice inlets. When properly installed to correlate with reservoir conditions, these valves will revolutionize gas lifting of either high or low productive wells which must be constantly flowed.

INJECTION CONTROL VALVES—
Designed as tubing purgers, these valves allow gas to be injected only when tubing pressure falls below desired level. They are specially effective where injection of gas in a well needs constant control, and were primarily developed for installation at isolated wells, where the CAMCO Intermitting Time Cycle Controller is located at a more accessible tank battery.

CAMCO

GAS LIFT EQUIPMENT AND SERVICE

EQUIPMENT and SERVICE SUPPLIERS' NOTES

Ramey Heads Ideco Domestic Sales; Burner Named Oklahoma Manager

T. A. Ramey, formerly sales manager for Unit Rig & Equipment Company, has joined the International Derrick &

LeRoy E. Burner

T. A. Ramey

Equipment Company M&E division as general manager of domestic sales.

A petroleum engineering graduate of the University of Southern California, Ramey joined The National Supply Company in California in 1934. He moved to Texas in 1937 as factory liaison engineer, and in 1940 transferred to the Southern division as a specialist in rotary drilling equipment. He joined Unit Rig in 1947.

LeRoy E. Burner, formerly special sales representative for The National Supply Company, has joined the Ideco Supply Store staff as district manager for Oklahoma. He will office in the Perrine Building in Oklahoma City.

Regan Forge Named Sales Agent For Camco Gas Lift Valves

Regan Forge & Engineering Company, San Pedro, Calif., has been named sales agent in California for Camco Gas Lift Valves, Paul Mills, chairman of the board of Camco, Inc., announced.

Regan will handle service and installations as well as sales. The first installations of Camco Valves were made in the Paloma field, near Taft, Calif.

Camco has now broadened its scope of service to the oil industry to include the U. S., Canada and California as well as sales representation in South America.

H. C. Smith Oil Tool Company Appoints Advertising Manager

H. C. Smith, president of the H. C. Smith Oil Tool Company, announced appointment of Harold H. Smith as advertising manager. Harold Smith has been active in the company as a sales representative for the past five years. For the last year, he has been assistant to the general sales manager.

Harold H. Smith

Larkin Opens Kilgore Warehouse

The Larkin Packer Company, St. Louis, has opened a warehouse in Kilgore, Texas, it was announced by T. E. Alexander, sales manager. A complete stock of Larkin products will be carried.

EQUIPMENT and SERVICE SUPPLIERS' NOTES

Three Kobe men at the opening of the new field service shop at Kilgore, Texas, are, left to right, Carl Brown, district manager; Russell G. Ralph, Mid-Continent division manager; and Ray Elner, Southern area manager.

Kobe Opens Kilgore Repair Shop

In expanding its field service program for hydraulic pump operators, Kobe, Inc., has opened a new repair shop at Kilgore, Texas, the third such shop to be set up in the past few months. In addition to facilities for servicing hydraulic pumps, the shop has a built-in test well in which every pump is run under field simulated conditions before it is released for service.

Lane-Wells Company Advances Baker To Division Operating Engineer

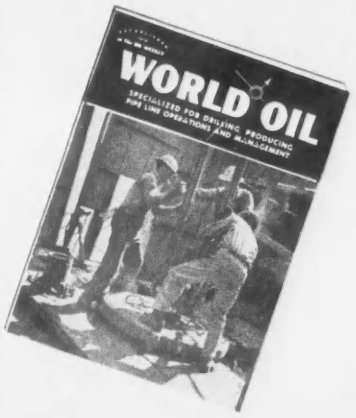
The Pacific Coast division of Lane-Wells Company has appointed J. Shannon Baker as division operating engineer. He is succeeded as district superintendent in Bakersfield, Calif., by W. J. (Doug) Taylor, formerly assistant superintendent.

J. Shannon Baker W. J. Taylor

Baker, who holds a B.A. degree in physics from the University of California at Los Angeles, joined the company in 1938, and most recently has been Los Angeles district sales manager. Taylor has been with Lane-Wells since 1941, except for three years in the Navy.

Turner to Rinehart

Don Turner, formerly attorney and assistant secretary, Sohio Petroleum Co. at St. Louis, Mo., has been made executive vice president and director of Rinehart Oil News Company, succeeding E. N. Redden, who has resigned as vice president and general manager.



announces its

GULF COAST
and CONTINENTAL SHELF ISSUE

—June, 1950

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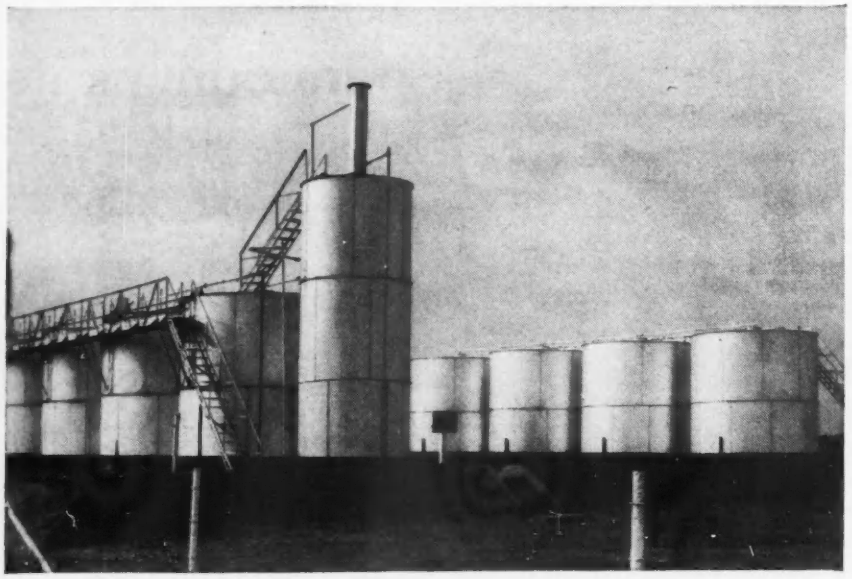
When your Wells come in...



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Galvanized steel tanks are also available. Here, Butler uses the hot-dip galvanizing process which produces a heavy coating of the galvanizing on every surface and gives complete protection from weather and corrosive elements.

Butler Bolted Tanks are built to A. P. I. specifications. Sizes and types to meet your needs. Call your nearest Butler oilfield organization today for complete information and prompt service.

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STAIRWAYS • UNIT HEATERS

EQUIPMENT and SERVICE SUPPLIERS' NOTES

Byron Jackson Transfers File To Wichita Falls Territory

B. A. Hilliard, Jr., general sales manager of Byron Jackson Company Oil Tool Division, announced the transfer of Jack File as sales representative. The new assignment for File, who will operate out of Wichita Falls, Texas, includes coverage of the central Texas oil fields.

Jack File

File, who joined BJ in 1936, has been sales representative in the San Joaquin Valley with headquarters in Bakersfield, Calif.

Sales and Service Territories Are Established by Tube-Kote

G. O. Carroll, sales manager of Tube-Kote, Inc., Houston, applicators of thermosetting, baked-on, plastic coatings for the oil and chemical industries, announced the establishment of sales and service territories to better serve customers throughout the industry.

The Shreveport area will be served by G. L. Garner; Kansas and Louisiana by Fritz Kohlhausen; San Antonio and South Texas by Len Edgar; and the middle Louisiana area by Bob Dwyer.

Manager of Shreveport District Appointed by National Supply

Robert A. Seale has been appointed manager of the Shreveport district for The National Supply Company. Seale has been engaged in oil industry work in the Shreveport territory since 1934, and was branch manager for Hughes Tool Company at Shreveport for 12 years prior to joining National Supply.

Robert A. Seale

He succeeds M. R. Brinkerhoff, district manager at Shreveport for the past ten years, who was recently appointed assistant division credit manager for the territory comprising Louisiana, Mississippi, Alabama, east Texas and southern Arkansas.

Two Vice Presidents Named by Marmon-Herrington Company

Fred B. Croner and George H. Freers have been named vice presidents of Marmon-Herrington Company. Croner was named a vice president in charge of procurement and Freers was named a vice president in charge of engineering.

For the past three years Croner has been responsible for the company's purchases of materials and supplies. Freers has been chief engineer for the past ten years.

EQUIPMENT and SERVICE SUPPLIERS' NOTES

Mack Appoints Four Executives To Head Key Company Divisions

A. F. Fenner, vice president of Mack-International Motor Truck Corporation,

A. F. Fenner

E. G. Ewell

has been named general sales manager, with headquarters in Chicago. He will direct all truck, bus and fire apparatus sales and service in the Central, Southwestern and Pacific Coast divisions.

E. G. Ewell, also a vice president, has been named general sales manager of the Eastern, Atlantic and Southern Sales divisions, and will headquarter in New York City.

Fenner joined Mack in 1915 as a salesman at Albany, N. Y. His most recent position was manager of the central division, to which he was appointed in 1927.

Ewell has been with Mack since 1924, and was most recently manager of the Southern division.

Pierce J. Fleming has been appointed manager of Mack's Off-Highway Sales division, and John Walker has been named Off-Highway Sales Engineering division manager. Both joined the company in 1918.

Huber Heads Wire Rope Division

Walter A. Huber has been appointed general manager of the Wire Rope division of John A. Roebling's Sons Company, Trenton, N. J. For the past nine years, Huber has been manager of Preformed Wire Rope Sales for American Chain and Cable Company, Inc.

Caterpillar to Build New Plant

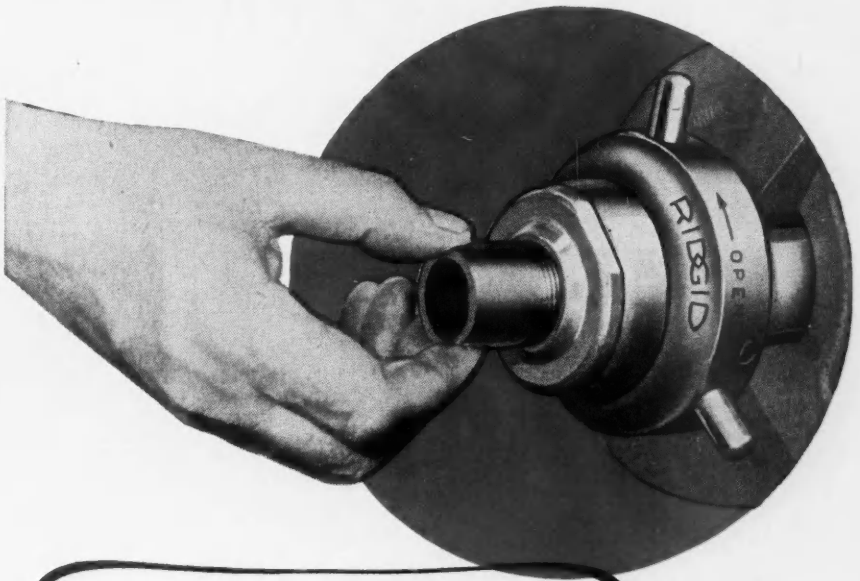
T. R. (Ted) Farley, vice president of Caterpillar Tractor Company, Peoria, Ill., has been named general manager of Caterpillar's new plant to be located two miles southwest of Joliet, Ill.

T. R. Farley

Farley joined Holt Manufacturing Company at Peoria in 1919, and was working in Chile in 1925 when Caterpillar Tractor Company was formed by the merger of Holt and C. L. Best Tractor Company. He was elected a vice president in 1940.

Caterpillar has acquired approximately 300 acres of land near Joliet for its new factory, which will manufacture bulldozers, scrapers, wagons and rippers.

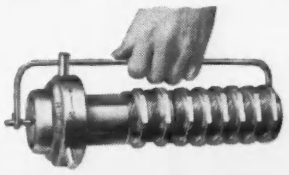
Extra-Easy Threading
OF SHORT NIPPLES



. . ."This RIDGID nipple chuck sure cuts the monkey-business out of threading short nipples."

New RIDGID Nipple Chuck fits any threading machine, power drive or vise

● Typical RIDGID worksaver advantages in this new nipple chuck—to speed every short nipple threading job! Fits any threading machine, power drive or vise—no special tools, parts or adjustments. No adjusting or changing of stop plug—it's an integral part of nipple chuck—automatically in position for use. Threaded nipple is released instantly by turn of nipple chuck—easily unscrewed by hand. Pipe adaptors for ¼" to 1½", chuck takes 2" pipe. Ask for this new fast efficient nipple chuck at your Supply House.



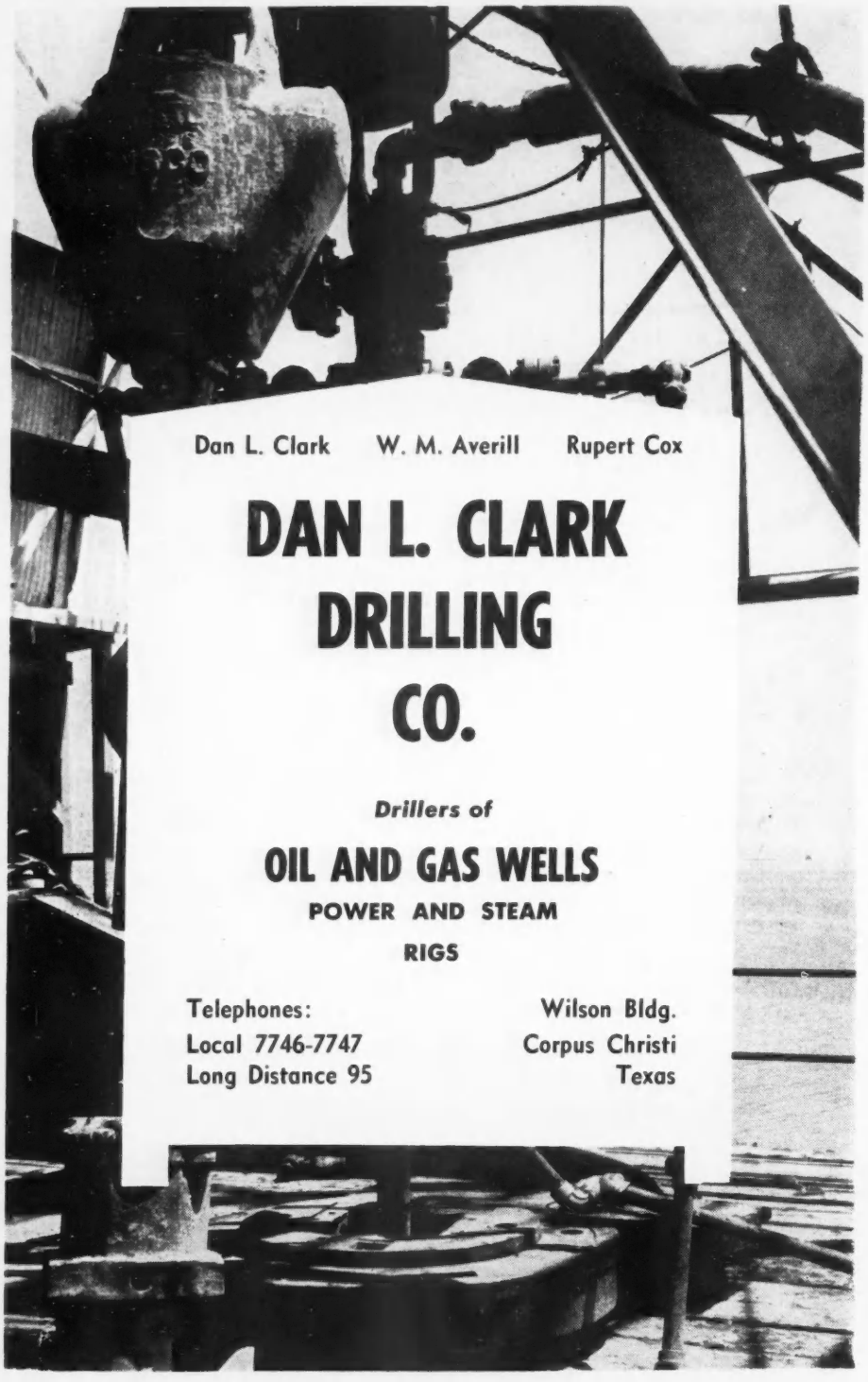
Free Patented Carrier for any set

RIDGID

WORK-SAVER PIPE TOOLS

THE RIDGE TOOL CO. • ELYRIA, OHIO

Key Members of Merla Tool Corporation and its distributing sales organizations are pictured at a recent Dallas sales meeting. Left to right are A. C. Mock, Merla Sales & Service Company, Houston; C. D. Fletcher, sales manager, Merla Tool; Malcolm Hudson, Hudson Eads, Inc., Wichita Falls; Art Robinson, Odex Engineering & Equipment Company, Odessa, Texas; V. A. Kagay, treasurer, Merla Tool; D. W. Henke, president; and Roy A. Lamb, vice president.



Service Engineer Appointed By Bucyrus-Erie Company

Appointment of William Couch as service engineer attached to the Evansville, Ind., office was announced by Bucyrus-Erie Company, South Milwaukee, Wis. He will handle service work on the company's line of oil well drills in the Michigan, Ohio, Illinois, Kentucky and West Virginia territory.

William Couch

Couch was associated with the H. C. Williams drilling Company of Grand Rapids, Mich., for six years, the last three as drilling superintendent. Most recently he worked as driller for Ford Oil Company, Holland, Mich., where he operated Bucyrus-Erie 28-L spudders. He spent three years with Ford before joining Bucyrus-Erie.

Morgan Heads Pipe Coating Firm

T. A. Morgan who has been general superintendent of Houston Industrial Gas Corporation and associated companies for four years, has resigned to devote his full time, as president, to Gulf Coast Pipe Coating Corporation.

T. A. Morgan

Morgan joined Houston-Gulf Gas Company, now United Gas Corporation, in 1926 as field engineer. He was with Lone Star Gas Company from 1929 to 1939, when he joined Houston Natural Gas Corporation as chief engineer. In 1946 he took over as general superintendent of Houston Industrial Gas Corporation. Morgan attended A. & M. College of Texas and Southern Methodist University.

P&H Executive Appointed

Harnischfeger Corporation, Milwaukee, has appointed A. G. Hendrickson as assistant sales manager of the P&H Welding division. Hendrickson served for five years as welding engineer in the Milwaukee and Minneapolis territories. Hendrickson will be assistant to Melvin O. Monsler, who was recently promoted from assistant to sales manager.

EQUIPMENT and SERVICE SUPPLIERS' NOTES

Jay P. Garner Elected

Jay P. Garner

Jay P. Garner has been named president of Oil Exploration, Inc., Tulsa. Garner was graduated from Rice Institute in 1935 and joined The Texas Company Geophysical department, remaining through 1945. In January, 1946, he assisted in organizing Oil Exploration, Inc., a geophysical company specializing in seismic surveys.

Kennedy Buys Semler Company

Purchase of the Semler Company, Jeannette, Penn., manufacturer of cast-iron pipe fittings, was announced by Charles F. Kennedy, president of The Kennedy Valve Manufacturing Company, Elmira, N. Y. Manufacturing operations will be continued at the Jeannette plant.

The Semler Company, with about 220 employes, has been engaged in the manufacture of cast-iron fittings since 1915. New officers of the company are Charles F. Kennedy, president; J. Lawrence Kennedy and Howard P. Semler, vice presidents; and Thomas S. Turkington, controller.

Dallas Parts Depot Contract Let

Construction has been started on the $1½ million Dallas service parts depot for International Harvester Company. The general contract was let to O'Rourke Construction Company.

The seventh in a chain of 12 depots throughout the U. S., the new installation will serve Texas, western Louisiana, and parts of Oklahoma and New Mexico.

C. B. S. Firm Formed

C. E. Buchner has formed the C. B. S. Engineering Company, Houston, and the firm has been appointed representative for Spartan Gas Lift Equipment Company. Buchner has spent many years in the oil industry, his most recent connection having been with Kobe.

C. E. Buchner

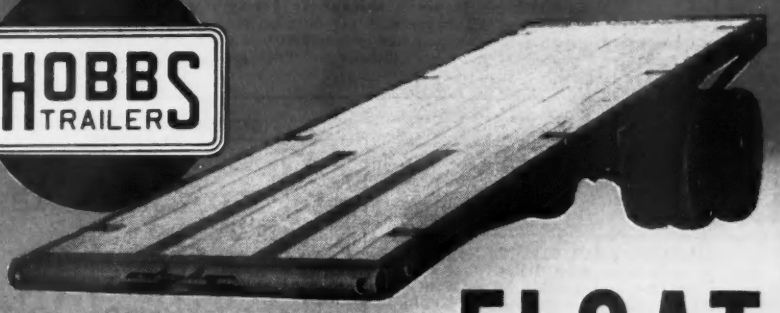
Failing Mexico Agent Appointed

George E. Failing Supply Company has appointed Jay C. Failing as agent for Mexico. For the past several years, Failing has been West Coast representative for the company, and he will continue to handle this territory in addition to his Mexican assignment. His headquarters are in Los Angeles, Seventh and Flower streets.

Load 'Em and Move 'Em

With One Man, a Winch and a

HOBBS TRAILER



SELF-LOADING FLOAT

Tandems Rated at 50,000--75,000--100,000 lbs.

Single Axle Model with 30,000 lb. Rating

Load drawn on float by winch line after float has been lowered to ramp position and tractor backed against rear end of float.

After load is in place, tractor is returned to front and float is raised to hauling position by means of winch.

Loaded and ready to go. Entire job done by one man, Hobbs Self-Loading Float, and winch-equipped tractor.

When you have something heavy to move you can always call on your Hobbs Self-Loading Floats. Developed and engineered in the oil fields, this equipment is ideal for moving rigs, draw-works, butane tanks, other heavy and massive units, bulldozers, road building equipment. Hobbs Self-Loading Floats are famous for saving time and labor — for their super strength, easy loading, long service. Write, wire, telephone or cable HOBBS MFG. CO., FORT WORTH, TEXAS, for complete details. (Please mention this publication).

HOBBS MANUFACTURING COMPANY

FACTORY SALES AND SERVICE — Fort Worth, Houston, San Antonio, Lubbock, Texas. DISTRIBUTOR SALES AND SERVICE — Hobbs Trailer Equipment Co., Dallas, Texas; Hobbs Trailer Sales Co., El Paso, Texas; H & H Equipment Co., Okla. City, Okla.; Hobbs Trailer Co., Wichita, Kansas.

HOBBS TRAILER

OIL FIELD and COMBINATION Bodies

The "Utility Men" of the Oil Fields

Sturdy all-steel bodies decked with oak or steel plate, equipped with drill-pipe gin poles and extra heavy, rolling tail pipe. Oil Field Body has king pin for engaging inverted fifth wheel mounted on trailing equipment; Combination Body has new cable-released fifth wheel to engage standard king pins.

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RATES: Regular Classified (undisplayed) set in this size type: 10 cents per word. If Box Number is to be used count an additional six words. Replies forwarded without charge. Situation Wanted: 5 cents per word. Display advertisements, set in suitably larger type with ruled border: $9.00 per column inch per insertion. Situation Wanted: $4.50 per column inch. **All classified ads payable in advance.** 10% Discount if 3 or more insertions are ordered at one time. **COPY DEADLINE:** 5th of month preceding date of issue. Send copy and checks to: Trading Post Section, World Oil, P. O. Box 2608, Houston, Texas.

FOR SALE

■ FOR SALE: Approximately 25 miles 4" OD plain end pipe in line. Public Service Corp. of Texas, 902 Burk Burnett Bldg., Fort Worth, Texas.

■ WELL DRILLING EQUIPMENT. New and used rotaries, spudders, core drills, shot hole and standard outfits. Tools, cable, pipe. Everything for well drilling. Pressey & Son, Pueblo, Colo.

■ ONE MODEL EC 104 Cardwell powered with 2 WAKU Waukesha Engines, Lee C. Moore 127½ foot Mast with 9' 8" x 40' Substructure, 7¼ x 16 Bethlehem Pump powered with LRO Waukesha Engine, 7¼ x 16 Wilson Snyder Pump Powered with 185 HP Buda Engine, and all necessary tools to complete rig. Rig is in first class condition, approximately 2½ years old. Recommended for 4000 to 7500 foot drilling.

ONE LARGE MODEL O Cardwell, with 2 Waukesha WAKU engines, 127½ foot Cantalever derrick with 9' 8" Substructure, 8 x 20 Gardner Denver Pump powered with Quad Diesel Engines, 7¼ x 14 Gardner Denver Pump powered off Drawworks engines, 9000 feet 4½" Drill Pipe with Reed Super Shrink Tool Joints, and all necessary tools to complete rig, including QRC Fluid operated 6000 lb. test Cameron BOP. Rig is in first class condition and approximately 1½ years old. 1222 South Staples St., Corpus Christi, Texas.

■ FOR SALE (Subject to prior sale)—3 Bolted tanks, 2 in original crates and 1 assembled, (100 Bbl.). 69'-14" 57# Drive Pipe; 170'-10¾" 41# Drive Pipe; 407'-10¾" 32.75# Casing 8Rd. Thd. Smls.; 3045'-8" 24# Casing 8Rd. Thd. Smls.; 6286'-7" 23# Casing 8Rd. Thd. Smls.; 8101'-3" 9.20# Tubing Smls.; 1453'-2½" Tubing EUE Smls.; 14,226'-2" 6.40# Regular 10Rd. Thd.; 375'-¾" Pumping Rods; 9-5" Orbit Gate Valves; 9-" Orbit Gate Valves; 3-2" Orbit Gate Valves; 3-2⅞" x 6" Parmco Combination Packer; 1-2⅞" x 6" Larkin Screw Trip Packer; 1-3" x 6" Parmco Packer; 1-2⅞" x 6" Gas Anchor Packer. M. B. Belden Office at 425 2nd St., N. W., Canton 2, Ohio, Phone 4-6147.

WANTED TO BUY

■ WANTED: Failing model 44, or 55 drill, or other make of similar capacity. Fred E. Butler, Box 1832, Casper, Wyo.

■ INDUSTRIAL USER Needs 14,000 to 15,000 gallons Bunker C Oil daily. Please quote price. Dexter Sulphite Pulp & Paper Co., Dexter, N. Y.

SITUATIONS WANTED

■ GEOLOGIST—30 yrs. old—2 yrs. roughnecking, 7 yrs. surface and subsurface geological work with major company in Canada, U. S., and South America, desires association with aggressive independent operator, or drilling contractor who is active in wildcatting. Prefer Rocky Mtn. area, or Canada. Pertinent details and references given on request. Address Box 73-W, World Oil, Houston, Texas.

■ ASSISTANT General Manager-Purchasing. Have had twenty-eight years experience in Oil Well Supplies, handling store and office management, personnel and purchasing. Married; age 48; salary open. Address Box 75-W, World Oil, Houston, Texas.

■ SUBSURFACE GEOLOGIST, successful foreign experience, seeks foreign or domestic post. Can also handle paleontology. Box 76-W, World Oil, Houston, Texas.

■ GEOPHYSICIST desires position, domestic or foreign. B.S. in C.E., three and one-half years geophysical experience, both gravity and seismograph, including work in Peru, Egypt. Presently employed as Civil Engineer. Twenty-seven, married, one child. Box 78-W, World Oil, Houston, Texas.

SITUATIONS WANTED

Exceptional Man Wants Exceptional Jobs

Practical experience in production and drilling, geological work and leasing. Sales Engineer for oil field equipment concerns, also field service. Supply Company experience. Good mechanical and design engineer, but have no degree or license. Construction experience. Sea experience, Captain of four 150,000 bbl. tankers, 2 years as Mooring Master and harbor pilot, foreign. Age 45, excellent health and appearance. Sober and reliable.

Desire unusual and difficult jobs of any nature. Confidential or otherwise. Remuneration based on results only if desired.

NOT INTERESTED IN A PERMANENT JOB ON FULL TIME BASIS.

If you have troubles and need someone outside of your organization, drop me a line and we will talk it over with no obligation unless we come to terms. Jobs in any part of the world considered. Box 74-W, World Oil, Houston, Texas.

HELP WANTED

Experienced Geologist

WANTED by well established, adequately financed independent oil company spending on development near two million dollars annually, for executive position experienced geologist familiar with North and West Texas. Must be man of broad experience in geological work. Applicant must be not more than 40 years of age. Satisfactory salary. If not employed now, do not apply. Correspondence strictly confidential. Write Box 77-W, World Oil, Houston, Texas.

EQUIPMENT and SERVICE SUPPLIERS' NOTES

Geologist Joins Kansas Consultant

Stephen B. Powell, formerly district geologist for Midstates Oil Corporation at Wichita, Kansas, has resigned to enter consulting work and has formed a partnership with Emmett R. Elledge of Wichita.

Stephen B. Powell

Powell was with The Atlantic Refining Company as scout and geologist from 1937 to 1942, and joined Midstates as district geologist in Kansas in May, 1945, after three years service in the Armed Forces. Powell majored in geology at Colgate University and took graduate work at Virginia Polytechnic Institute.

Mid-Valley Announces Engine Award

Mid-Valley Pipe Line Company has let a $½ million contract to The Cooper-Bessemer Corporation, Mt. Vernon, Ohio, for gas-diesel engines for driving the oil pumps on Mid-Valley's 22-inch diameter, 1000-mile oil pipe line from Longview, Texas, to Lima, Ohio.

Scheduled for delivery in May, the engines totaling more than 10,000 horsepower will be installed in four of the seven pumping stations this summer.

Continental Names Managers

The Continental Supply Company has appointed F. W. Gaushell manager of the Alice, Texas, Store.

O. A. Kent, formerly a field salesman, has been named manager of the El Dorado, Kansas, store.

HELP WANTED

■ WE HAVE openings for experienced gravity crew men in foreign work. Excellent working conditions. All expenses and opportunity to advance and save money. Exploration Surveys, Inc., 5615 Daniels Avenue, Dallas 6, Texas.

NOTICES, SERVICES

■ MOTORS — Generators — Transformers — Diesels — Compressors — "World's Largest Inventory." New and Rebuilt. Electric Equipment Company, Phone LD 65, Rochester, N. Y.— P. S. We will buy your surplus for cash.

■ TO SETTLE ESTATE, approximately 142 acres in Bexar and Atascosa counties. Not far from, and in line of heavy oil production. Box 184, Somerset, Texas.

Experienced Geologist seeks capital backing for application of a new and technically sound method of mineral prospecting. For details write Box 72-W, World Oil, Houston, Texas.

LEASES, DRILLING, ACREAGE, ETC.

■ 80 ACRE LEASE in Artesia pool for sale with drilling obligation—Shallow. 640 acres in Loving County, Texas—shallow, Delaware, and deeper; between Wheat Pool and Kyle Pool. Large tract in Panhandle in trend 1⅛ to 3 miles from a pool of ten producing wells. John P. Mathis, P. O. Box 1106, Amarillo, Texas.

New Books, Maps and Movies

Oil Yearbook

Ira Rinehart's 1950 Yearbook contains all the features of the previous ten editions, in addition to new articles of interest to the industry. The two volumes are divided by regions, and contain data on every new oil and gas strike during the past year, and every new sand discovery in the U. S. Statewide production figures and record of wells drilled in each of 22 states are included.

Financial transactions of the industry are discussed in a separate section, which also has a review of new taxes proposed for the petroleum industry.

About 75 maps of new oil and gas fields are included in the "Silver Anniversary Yearbook 1950."

Rinehart Oil News Company, P. O. Box 1208, Dallas, $15 for non-subscribers, $10 for subscribers.

Drilling, Production Practice

The 1948 issue of "Drilling and Production Practice" contains papers selected by the Publications Committee of the API's Central Committee on Drilling and Production Practice from papers presented at national and district meetings of the Divsion of Production in 1948.

Drilling and production equipment developments, advancements in offshore operations techniques, regional reports, and basic engineering data are presented in the papers.

The Secretary, American Petroleum Institute, 50 West 50th Street, New York 20, $5.

Petroleum Engineering

All papers on petroleum engineering and much of the conference discussion at the Colorado School of Mines 75th Anniversary celebration are included in "Petroleum Engineering," Vol. 45, No. 3B of the *Quarterly* of the school.

Papers include "Gas-Condensate Fields," by William Emmett Brown, chief engineer, Mid-States Oil Corporation, Tulsa; "The Valuation of Oil Properties for Secondary Recovery," by R. C. Earlougher, consulting engineer and owner, Earlougher Engineering, Tulsa; "Secondary Recovery of Petroleum," by Paul D. Torrey, president, Lynes, Inc., Houston; "Petroleum Conservation and Conservation Laws," by D. V. Carter, chief petroleum engineer, Magnolia Petroleum Company, Dallas.

Department of Publications, Colorado School of Mines, Golden, Colo., 50 cents.

Canadian Oil Economics

Concise guidance to preliminary financial questions of U. S. corporations and persons interested in exploring and drilling for oil in Canada, and the related supply and equipment field, is provided in "For Oil and Allied Industries," a booklet of useful facts about Canada.

Topics included are foreign exchange control; income taxation, both corporate and individual; types of incorporation for Canadian operations; leases and reservations in Alberta and Saskatchewan; oil and natural gas conservation and taxation legislation in Alberta; customs regulations; immigration; and exploration for oil in Western Canada. Statistics on Canadian operations are presented in tabular form, and a separate map of oil and gas fields is included.

The Canadian Bank of Commerce, Toronto, Ontario, Canada.

Rocky Mountain Data

"Resume: Rocky Mountain Oil and Gas Operations for 1949," the 20th annual compilation of data on the area, contains 185 pages of factual material. Leasing, drilling and development in Nebraska, Utah, Wyoming, Colorado and Montana are discussed, and reports on discovery wells, units and geophysical activities are included. In the statistical section are figures on discoveries and well completions for the area, production, and refineries and cracking plants.

All material in the yearbook is original and a number of the maps are published for the first time.

Petroleum Information, Inc., Continental Oil Building, Denver, and P. O. Box 2452, Casper, Wyo., $10.

ARE YOUR WELLS SUFFERING FROM
PARAFFINITIS*?
Wells afflicted with this disease can be cured by the installation of Huber Paraffin Scrapers. They are not just a temporary relief, but a Permanent Cure. Your wells will never again need costly steaming out or the rods pulled to keep them on production.
Huber scrapers, shrink-fitted to the rods and placed in the area of accumulation, wipe the tubing walls clean of paraffin as the rods are rotated and reciprocated. It is as simple and efficient as that.
ROTATION . . . a double benefit
Huber scrapers combined with a Huber Rotating Rod Hanger give double benefit in paraffin removal. The resulting rotating and reciprocation motion wipes paraffin from the tubing in particles so small that they go out in solution . . . can not clog tubing, scrapers, or flow lines. Double benefit rod rotation prolongs coupling life by equally distributing wear . . . prolongs pump life and efficiency by equalizing wear on working barrel.
* Congestion caused by the accumulation of paraffin in pumping wells.
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SCRAPE AS THEY ROTATE
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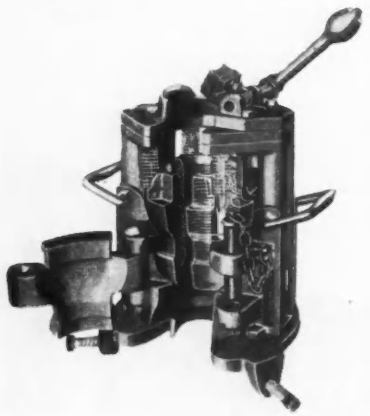
THE TUBING SPIDER PREFERRED by ROUSTABOUTS and OPERATORS

Well service crews can turn out their work more safely and in less time with the O'Bannon Automatic Tubing Spider.



AUTOMATIC:

Coming out of the hole, any downward motion of the tubing, intended or accidental, sets the slips. Going in, slips are set automatically when roustabout releases soft line attached to dog jaw.

SAFE AND FAST:

Crew stands clear of well head while slips are engaged or released and while tubing is in motion. No handling of slips by a roustabout. No time lost in setting slips by hand.

ECONOMICAL:

Wearing of slips is minimum, because they hang clear of tubing while it is in motion. Inexpensive dog jaw rides tubing.

2", 2½" or 3" Tubing can be handled. Each spider comes equipped with slips and guide ring for one size, additional slips and guide rings being required to handle other sizes. Changing from one size to another is easy and fast.

Ask your O'Bannon Representative to demonstrate one of these spiders on your next tubing job.

•

Sold by Supply Stores

WALTER O'BANNON COMPANY

Tulsa 1, Oklahoma

"No, they didn't strike oil—it's lunch time!"

Hurry Up and Wait

"They've developed a plane that will take people around the world in an hour!"

"Better make that two hours. One hour to get around the world, and the other to get home from the airport."

Twice Blessed

A woman in Tennessee had four sets of twins in five years. This is what is known as "deuces wild."

Deduction

"Gus," said Bill, as he caught up with Gus on the way back to camp, "are all the rest of the boys out of the woods yet?"

"Yep, said Gus.

"All six of them?"

"Yep, all six of them."

"And they're all safe?"

"Yep, answered Gus, "they're all safe."

"Then," said Bill, his chest swelling, "I've shot a deer."

Altruistic

In the course of a hot-tempered telephone conversation with a high-powered movie producer, a harried screen writer was moved to remark: "Take it easy, will you? If you're not careful you will get ulcers."

To which the producer snarled back: "I don't *get* ulcers. I *give* them."

Remains

"Mom, it is true that we came from dust and we'll return to dust?"

"Yes, dear. That's what the Bible says. Why?

"Cause I just looked under my bed and there's somebody there, either goin' or comin'."

Specify **PELCO**

Welding Saddles

PELICAN WELL TOOL & SUPPLY CO.

P. O. Drawer 1108

Shreveport (84), La.

SEE YOUR NEAREST SUPPLY HOUSE

Announcing the **NEW**, *Revolutionary*

McCULLOUGH

Reg. U. S. Pat. Off.

Heat Treated

GLASS JET

Perforators!

PRODUCTION *when other methods fail!*

Get RESULTS in your well, when other methods fail, with the NEW, revolutionary McCullough Heat Treated Glass Jet Perforators!

We want the TOUGH jobs! In small pipe, large pipe, bad pipe, several strings of pipe—any job where other methods have failed. Why do we want the TOUGH jobs? Because NEXT TIME you'll ask for the Glass Jet FIRST!

Over 15,000 of these McCullough Glass Jets have been shot in oil wells, everywhere, without a single stuck gun, carrot or any debris left in the well! This means clean, efficient, trouble-free jet perforating for the first time! In many instances, oil wells have been successfully re-perforated, when all other methods had failed to get results!

If you want MORE PRODUCTION and you believe that DEEPER penetration will get it for you, ask your McCullough service man about the NEW McCullough Glass Jet Perforators TODAY!

WHY YOU GET MORE PRODUCTION

RESULTS—DOUBLE the normal amount of explosives are used in the Glass Jet compared to guns of equal sizes. MORE explosives mean DEEPER penetration.

WHY GLASS—The special glass units are heat treated to 20,000 lbs. P.S.I., withstand temperatures as high as 1200° F., and completely disintegrate leaving no debris in the hole.

BETTER PERFORATIONS—The Glass Jet maintains a straight sided hole for a greater distance, does not taper-off rapidly, NO CARROT OR SLUG left to plug the holes!

EXPLOSIVES—Made, loaded and sealed at the factory. Will withstand high temperatures without detonating prematurely.

POSITIVE SEAL—Each glass container is individually and positively sealed at the factory against leakage.

SOLID STEEL GUN BODY FOR 5¾" AND LARGER PIPE—Allows use of a greater charge of explosive in a smaller gun without danger of splitting or sticking. Permits placing jet charge closer to the casing where all its energy is fully realized. Spacing—1, 2, 3 or 4 charges to a foot.

EXPENDABLE CARRIER FOR SMALL PIPE—Permits, for the first time, a large charge of explosive in small pipe resulting in DEEPER penetration, even through several strings! Spacing—1, 2, 3 or 4 charges to a foot.

AVAILABLE NOW!

See your McCullough service man TODAY for complete information!

McCullough TOOL COMPANY

5820 South Alameda St., Los Angeles 11, California
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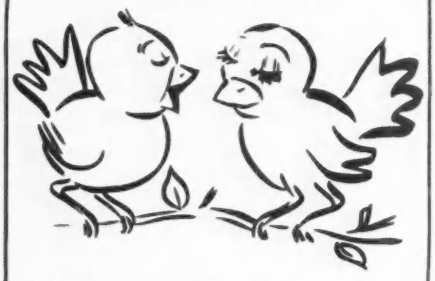
EXPORT OFFICE: 30 Rockefeller Plaza, New York 20, N. Y.

Flashes from the BEACON

REMEMBER a rather modest challenge we threw down recently in this column? We mentioned that our BEACON "subscribers" numbered 12,000 and asked, "Why not be 12,001 on our mailing list?" . . . and we got taken up muy pronto by a number of readers. One man actually said, "I would like to be number 12,001 on your mailing list for the BEACON."



"Hasn't anyone ever told you about the people and the bees?"

a BEACON *Original* by Dave Hunt

* * *

AS A MATTER OF STRICT FACT the number 12,000 was a "statistic" representing only an arbitrary pause for counting. Quick as the gentleman was, the growing BEACON list was even quicker. But we like the sentiment enormously, and we hereby make him Honorary 12,001 for all time and thus he is enshrined in our hearts.

* * *

NEWEST STAR in our "parade of cities" is beguiling New Orleans. Lucky-dog-type feature writer Chauncey Black bagged the New Orleans assignment and reports enjoying the research involved. Read the colorful results in the BEACON for May.

* * *

Want to join the BEACON brigade? Just let us know on your letterhead.

Write to:

BLACK, SIVALLS & BRYSON, INC.

Industrial and Public Relation Division
720 Delaware
Kansas City, Missouri

SQUEAKS from the BULLWHEEL

Inevitable

Paratroop instructor: "All you have to do is jump, count to ten, pull your rip cord, and your parachute will open."

G. I.: "What happens if I forget to pull the cord?"

Instructor: "That's what we call jumping to a conclusion."

Where Credit's Due

It was the morning after a riotous party. Maggie, who was always a judicious celebrator, managed to rise from her bed in a fairly good condition; not so with Burt, her husband, who was in a terrible state. He sat holding his head and groaning.

"Burt," his cautious mate admonished, "I warned you last night. If you hadn't drunk so much, you wouldn't feel so horrible this morning."

"Drink had nothing to do with it," the afflicted man groaned. "I went to bed feeling marvelous and woke up feeling awful—it was the sleep that did it."

Call to Duty

The curvesome beauty glided into the room dressed in a creation designed to cover no more than the imagination.

"Who made her dress?" asked the envious wife.

"I'm not sure," said the husband, "but I think the police should."

Current Events

The engineer was questioning the job applicant. "Do you know anything about electricity?" he asked.

"Yes, sir," was the prompt reply.

"Sometimes I wish you had never gone into the pipe line business!"

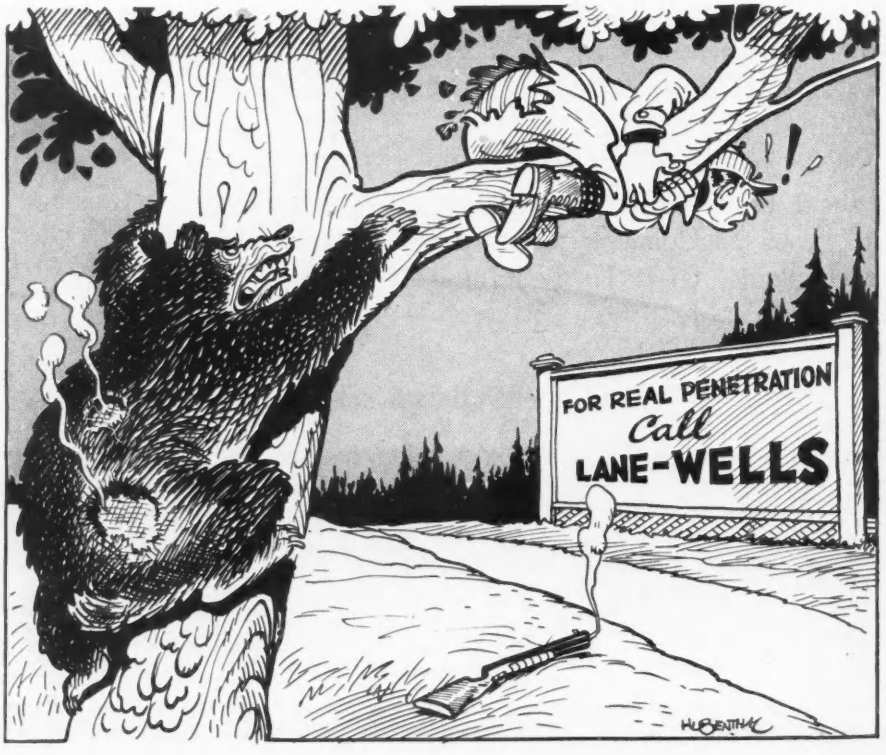
"What's an armature?"

Applicant: "A guy that boxes for nothing."

Next Question, Please

A typical law school student one day took his first case to court. Looking sternly at the witness, he asked, "How close were you to the place the accident occurred?"

"Fifty-three feet and three and one-half inches," answered the witness.

"How can you say that so exactly?" inquired the surprised lawyer.

"Well, I figured some silly fool would ask me a question like that, so I measured it."